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INCIDENTAL POINTS IN THE SALE OF POWER.

The marketing of electrical energy is a peculiar business. It has taken the world a good while to learn this, but gradually the patient work of lighting and power companies in the direction of giving the public an insight into some of the difficulties of electric generation and distribution is bearing fruit. Less and less do we hear petitioners at hearings before public-utility boards inveighing against rate systems because they are more intricate than the grocer's tariff on molasses, and more and more does one find the consumer of electricity cognizant of the fact that he is buying a service whose costs are dependent upon the time of day when that service is rendered, the demands which his neighbors are making upon the company, and many other factors which preclude the issuing of bills like those based upon transactions of elementary commercial character.

Not so clear to the public are some of the so-called incidental advantages of electric service, and particularly those attached to the introduction of power into varied industries and fields of human activity. It is reason for congratulation that the more intelligent public no longer becomes incensed when a bill for power consumed appears in two subdivisions, one being proportioned to the investment and stand-by charges required to maintain a great system in constant readiness to supply every customer without even the notification possible through a telephone call, and the other proportioned to the mere expense of operation, which is not seldom small when compared with the cost of standing at the consumer's door prepared to deliver service at any time in the twenty-four hours. Slowly but surely the consumer is being educated to see that in the supply of electricity, as well as in every other department of civilized life, the cost of being prepared is the great element, and alas, the one most often neglected. Now it is time for him to take another step forward, and that step is to give more weight to the auxiliary benefits of the motor-driven installation when comparing old conditions with what it is anticipated will result from the introduction of electric service.

The average prospective consumer of electric power knows in a general way that this service is simple and clean, but it takes a good deal of time to convince him that it is cheaper than the former means of running his machinery. The solution of the problem along the main line of cost determination is plainly the first and last duty of the central station. It is

significant that companies most successful in getting business of this kind in the face of acute competition do so by adopting, so far as possible, the figures to which their prospective customers will agree. But there is still more to the matter than this, and the thing calling for real skill in power solicitation is the setting of value upon what would ordinarily be called the incidental features of the power situation. Any good engineer can make a test of the steam required to drive a given shoe factory, but it takes something more than this to introduce electricity into establishments whose test figures show that on the basis of daily running cost, electric service may in specific cases come a little higher than steam or gas.

A few illustrations of the line of thought to be followed may be pertinent. Only in a very few instances is any credit given in figures to the value of space released by a motor drive, compared with that occupied in the old régime. Plenty of people are paying from ten to twenty-five cents per square foot per month in rentals of establishments in which out-of-date machine installations driven by steam or gas are eating up good money every day and night in the year. Yet very few central-station power men can open their notebooks and show the consumer what the installation of one or more motors of a given size will mean in rent-saving as compared with the cost of keeping up the old plant space. Common sense tells the manager that his space must be worth something per square foot if it is worth what he considers a high rental in the total, and here is a place where not a few closely matched sets of costs can be turned in favor of electricity. Another clue worth running down in some cases is the possible saving in insurance rates which ought to follow the substitution of motors for a mechanically operated gas-engine equipment offering something of an interior hazard, assuming, of course, a motor installation with conduit wiring and protected starting switches or boxes. Getting rid of an old engine room saturated with the oily drips of many a year's running is another point of contact with the economic problem. These things mean money saved—or will mean it, if enough operating companies push the matter.

Too little consideration is given to the convenience of electric driving in particular fields. With it there are no heat losses when the machinery is standing still and no waste of heat other than the generic losses in the motors and wiring while the local equipment is being started and stopped. With a steam plant the owner pays heavily for periods of underloaded operation. It costs him real money. He seldom knows much about it, but when the electric solicitor who knows his business enters the works light should be turned into some of these corners, showing an unsuspected hole in the pocketbook. In difficult power cases it will pay to determine the cost of starting and stopping the plant by steam or gas, bearing in mind the quality of skilled labor required as compared with the cost of throwing in a few motor switches. It pays early in the day to try to find out what the value of ten minutes is to an industrial plant, and to estimate the reasonably certain savings of the more reliable motor service. The industry needs more information concerning the extent to which production has been increased by the adoption of electric driving. Accurate figures of this character have been sought but they are too frequently obscured by the fact that a change to electric driving was accompanied by other alterations in the property which made it almost impossible to determine how much of the gain was due to electricity and how much to such things as the rearrangement of plant, the introduction of cost accounting capable of showing the management what is going on in sub-departments, and contemporary movements in the direction of giving employees better training. Let the central station begin to keep more detailed records as to the performance of individual motor-driven machine tools and appliances, and much of the difficulty will disappear.

THE CHICAGO BUREAU OF PUBLIC EFFICIENCY.

Although it can hardly be expected that the governing boards of a city shall be supplied with technical knowledge, there is sometimes a deplorable reluctance on their parts to either admit the fact or take the advice of experts who are called for consultation. Experts employed by the city are powerless because of prevailing conditions to carry out their plans of betterment.

The work of the Chicago Bureau of Public Efficiency, of which mention is made on another page of this issue, has been carried on for the purpose of calling attention to public inefficiency. Its report on electrolysis is work that should have been done before by the city, instead of being left to a private organization.

The Bureau, supported entirely by private subscription, devotes its entire time and effort to the problems, chiefly engineering, which the city employees appointed too often for political reasons, investigate imperfectly or pass over entirely. The results of its investigations are printed in bulletin form and given to the public.

As a result of the electrolysis investigation it was pointed out that it was largely owing to leakage from the rails of the local surface lines that there was extensive electrolytic corrosion and an actual loss of two-thirds of the water that was pumped by the city. Attention was also called to the fact that there had been a fund of $10,000 appropriated for the investigation of electrolytic conditions, and that the investigation had never been made. The money had been diverted piecemeal into other channels. Added to this is the fact that the city engineer repeatedly called for an electrolytic survey and was unable to secure it.

It would hardly be within the province of the railway company to make excavations in order to determine the condition of pipes which might be affected by its leakage current, nor would it be expected to make a survey of the city for a determination of voltage drop between rails and water plugs. Even the city in this case did not feel itself called upon to determine the extent of the damage done to its own property.

In contrast, the action of the gas company, a privately operated concern, might be cited. This company not only made a survey of electrolytic conditions, but bonded the pipes to the rails in the positive territories. The damage was in this way greatly lessened.

The damage done to pipes all over the city has been greatly lessened by the work of the railway companies in reducing the resistance of their return circuit. Welds and bonds have been supplemented by a copper cable laid between the tracks, making the return circuit the most perfect of any street railway system in the world. Conditions have improved enormously since the survey was made by the Bureau.

The value of such an investigating body as the Chicago Bureau of Public Efficiency can hardly be overestimated. The engineers employed are neither prejudiced in behalf of the city nor of an operating company, but endeavor to give the public a fair report of conditions as found by a careful and thorough investigation. The work the Bureau is doing is commendable and its investigations should be carefully noted by the city boards who have power to carry on municipal work.

THE ADVANTAGES OF REFRIGERATION BY ELECTRIC POWER.

The economy of developing refrigeration through the medium of motor drive upon the premises where the refrigeration is required, has been amply demonstrated by numerous examples giving the data of relative cost which have appeared in our reading columns from time to time. Florists, butchers, ice-cream makers, hotels, saloons and many other lines of business have changed from the use of ice to motor-driven refrigeration with great advantage in a financial way, which has been plainly evidenced by the records in the cash book.

The great inconvenience of handling the ice is also done away with and cleanliness, health and many minor conveniences result.

An additional advantage in the case of butcher shops and one that can well be cited by solicitors in persuading prospective customers to make this change has not perhaps been sufficiently emphasized. It is found that where meat is stored in juxtaposition to ice a discoloration of the surface results, which makes it necessary to do considerable trimming before the meat can be displayed to customers for sale. It has been estimated that this daily trimming amounts to about eight per cent of the stock, and a large financial loss therefore ensues on all stock which must be carried over from day to day. This discoloration does not occur in meat boxes which are cooled by artificial refrigeration in place of ice, and this saving in material, in labor and time should therefore be considered in comparing the relative merits of motor-driven refrigeration with the direct use of ice. It is an argument which will carry considerable weight in the mind of the butcher who has been in the habit of scrapping an important percentage of his stock every day.

FINDING TROUBLES WITH MOTOR DRIVE.

One advantage which is inherent in the use of the individual electric drive is the fact that by the insertion of a meter in the circuit it is very easy to determine the amount of power being used in any particular machine. This is useful not only in determining the cost of any particular work, but also in locating troubles. Troubles of a minor nature often exist, and continue for long periods without coming to light, because they are not of such a nature as to cause a shut-down of the machinery, and yet they may be matters which should have immediate attention. Usually when anything goes wrong in this way an increase in power consumption results. With an occasional check on the amount of power being used it is possible to locate the trouble before it reaches a serious point.

An instance of this kind came to light recently in which the bearing on a small motor had become broken and a piece of the bearing had dropped out. The motor continued to operate but consumed an abnormal amount of power, and it was only through this fact that the trouble was discovered and located, and this was done before any serious damage resulted. With steam-driven machinery such accidents go undetected until they result in some serious breakdown.

PRINTED INSTRUCTIONS.

The Dayton Power & Light Company has found its printed "Meter Department Regulations" so useful that a new edition has been published. This booklet contains instructions for the employees of the meter department, and covers installing, inspecting and testing. The precautions to be observed at each point of the work are especially emphasized, and an occasional reference to these regulations should prevent employees from becoming careless or forgetting any of the little details which are so essential to the most successful operation.

New employees are often started upon work with verbal instructions entirely inadequate to acquaint them with the methods and practice which have become almost second nature to the old employees. The latter sometimes do not realize that things may be done in an entirely different manner in other places, and that a new man may be entirely competent to do the work and yet entirely unfamiliar with the methods in vogue locally. Consequently men frequently start out on new work with insufficient instructions. The practice of putting into cold type and supplying to each employee those regulations which are to govern the general practice of the department is an excellent one and could be followed with advantage by other companies. Every help to good metering is a direct financial gain.

Even the seasoned employee sometimes overlooks some of the points which should be covered by an inspection or test, and the reference to printed instructions is likely to result in more thorough work.

Supply Jobbers' Saratoga Springs Convention.

The Summer convention of the National Electrical Supply Jobbers of the United States was held at Saratoga Springs, N. Y., August 16, 17 and 18. Headquarters were established at the United States Hotel. Several important business sessions were held, when the jobbers listened to spirited discussions of many phases of their activities. It was decided to hold the next meeting at Hot Springs, Va., the second week in November.

The feature of the meeting was the entertainment provided by the General Electric Company. On Thursday morning the entire party was conveyed in special cars and automobiles from Saratoga Springs to Schenectady, where the balance of the morning was spent visiting the shops of the company. The switchboard department and the porcelain department came in for a large share of attention, but the splendid facilities and highly modern shop practice of the wiring-devices department received the unstinted commendation of everyone present. Luncheon was served at the Golf Club, and after witnessing the teeing off in the golf tournament, those not playing were driven over the beautiful roads around Schenectady, Troy, Ballston, Saratoga Springs, Glens Falls, Saratoga Lake, Round Lake and Lake George. Some forty automobiles were chartered from local garages, and these were supplemented by the use of the cars owned by the members of the staff of the company.

In the evening the golfers were brought from the links and all the cars returned to Arrowhead Inn, at Saratoga Lake, where a delightful repast was served. There was plenty of good chorus singing, the verses being read from a beautiful souvenir booklet presented to those in attendance by the General Electric Company. During the dinner the exercises were enlivened and graced by the singing of W. E. Robertson and H. H. Cudmore and the enthusiastic leading of some of the chorus singing by Harry Grant furnished much amusement. Following the dinner C. C. Sibley announced the winners of the golfing trophies, the jobbers' first going to the genial and popular Fred Fullerton, second going to Howard Hall. The manufacturers' first prize went to W. H. Bauer, the second going to A. H. Pease. The remaining gentlemen's prize was won by Major Robert Edwards.

In awarding the ladies' prizes, Mr. Sibley called upon B. M. Downs, who presented in his innimitable style, first prize to Mrs. C. C. Sibley, and second prize to Mrs. H. H. Hornsby. Both ladies responded very gracefully. Thomas W. Debevoise made a brief address upon the cooperation of the electrical industry and the Sons of Jove, and the entertainment concluded with a minstrel show, that consummate artist, Thomas H. Bibber, giving a greatly enjoyed German dialect monologue on "War." The minstrels pulled off a great many local hits that were greatly enjoyed, and altogether the talent, though amateur and recruited from among the General Electric boys, presented a highly creditable performance. Messrs. Deming and Jackson were particularly active in arranging for the comfort of the visitors, and C. A. S. Howlett was master of ceremonies in the singing and minstrel entertainment.

At the close of the entertainment the party was conveyed in large touring cars to the hotel at Saratoga Springs, thus winding up a most enjoyable and profitable round of pleasure. The meeting was voted the most satisfactory yet held, and it was well attended by a thoroughly representative group of jobbers and manufacturers. Among those present were:

Franklin Overbagh, general secretary of the Association; Marshall L. Barnes, president of the National Electrical Contractors' Association; Frank H. Gale, Schenectady; A. F. Hills, Syracuse; Leon H. Frank, Wheeling, W. Va.; James Jackson, Paterson, N. J.; W. H. Tucker, New York; Robert Kuhn, Detroit; B. H. Scranton, Detroit; J. B. Ward, Boston; D. C. Gidley, Boston; A. N. Palmer, Providence, R. I.; E. J. Erwin and A. H. Erwin, Boston; P. H. Hoover, New York; W. M. Deming, Schenectady; H. E. Bibbins, San Francisco; C. H. Hobson, Dallas, Texas; W. N. Matthews, St. Louis; Alpha H. Kling, Detroit; Thomas W. Debevoise, New York; Frank S. Price, Boston; J. Robert Crouse, Cleveland; E. R. Bryant, New York; H. H. Cudmore, Cleveland; Sam A. Chase, Pittsburgh; Robert Edwards, Montreal; F. A. Burke, Atlanta; A. H. Pease, Hartford; C. C. Sibley, New York; H. E. Page, Hartford; A. M. Little, Syracuse; P. S. Klees, Hartford; W. T. McCullough, Pittsburgh; McKew Parr, Hartford; T. H. Bibber, New York; E. C. Graham, Washington, D. C.; Thomas G. Grier, Chicago; H. W. Bliven, New York; E. J. Johnson, Boston; A. L. Schantz, Buffalo; Fred Adam, St. Louis; W. S. Bissell, Toledo; Herman Andrae and Fred Andrae, Milwaukee; L. Guesser, Cleveland; G. M. Stuart, Boston; J. A. Campbell, Detroit; E. W. Rockafellow, New York; A. L. Millard, Chicago; G. S. Milner, Cleveland; N. C. Cotabish, Cleveland; H. R. Worthington, Jackson, Fla.; J. F. Greer, Chicago; A. P. Eckert, New York; M. B. Wheeler, Houston, Tex.; C. B. Hawley, Salt Lake City; H. T. Paiste, Philadelphia; H. S. Sands, Wheeling, W. Va.; W. W. Low, Chicago; L. W. Kittman, Chicago; James Wolfe, Chicago; T. C. Ringgold, Chicago; F. B. Gleason, San Francisco; Washington Devereaux, Philadelphia; F. R. Bryant, Chicago; W. P. Upham, Dallas; J. H. McGill, Valparaiso; E. K. Patton, Chicago; George V. W. Ingham, Chicago; F. S. Skeel, Chicago! J. B. Terry, Cedar Rapids; Albert Smith, Milwaukee; George Cutter, South Bend, Ind.; W. W. Merrill, Chicago; George S. Searing, Chicago; C. L. Eshleman, Cleveland; V. R. Despard, Chicago; D. L. Markle, Chicago; H. L. Grant, Chicago; W. H. Colman, Chicago; J. E. Way, New York; C. E. Corrigan, Pittsburgh; V. C. Gilpin, New York; H. H. Hornsby, New York; F. W. Fullerton, New York; Oscar Turner, Birmingham; Julien Binford, Richmond; George Beatty, New York; M. B. Austin, Chicago; P. S. Dodd, Cleveland; P. F. Bauder, Cleveland; R. E. Campbell, Cleveland; W. F. Irish, New York; L. G. Mockenhaupt, Chicago; H. F. McGuyer, Providence, R. I.; F. E. Stow, Philadelphia; J. A. Vaughan, Philadelphia; C. W. Price, New York; A. A. Gray, Chicago; Oscar Carman, Cincinnati; George C. Osborn, Harrison, N. J.; E. J. Kulas, Cleveland; F. M. Hawkins, New York; B. M. Downs, New York; D. C. Hemingray, Covington, Ky.; J. B. Olson, New York; A. D. Babson, New York; R. L. Jaynes, Pittsburgh; V. L. Gates, Pittsburgh; L. H. Keller, New York; W. H. Bauer, New Orleans; Gerald W. Hart, Hartford; W. J. Dougherty, Montreal; W. I. Patterson, New York; F. D. Masterson, Boston; F. B. Smith, Boston; W. W. Mumma, Springfield, Ohio; S. B. Condit, Jr., Boston; A. E. Williams, Warren, Ohio; John M. Klein, Chicago; E. V. Hennecke, Pittsburgh; E. H. Haughton, Chicago; H. C. Rice, Cleveland; H. A. Breverton, Cleveland; D. H. Murphy, Pittsburgh; H. B. Crouse, Syracuse; J. R. Jones, Utica.

Pennsylvania Electric Association.

The fourth annual convention of the Pennsylvania Electric Association will be held at Conneaut Lake, Pa., on September 6, 7 and 8. The program of papers will be announced later. The Entertainment Committee is arranging a series of sports, competitions, etc., for which prizes will be offered.

Milwaukee Manufacturers' Exposition.

Milwaukee is to have a manufacturers' exposition, September 2 to 12, 1911, at which only "made in Milwaukee" products will be exhibited. This affair is to commemorate the fiftieth anniversary of the Merchants and Manufacturers Association of Milwaukee, which organization has done much to advance the interests of local industries.

In view of the many important electrical companies located in Milwaukee the coming exposition should offer much of interest to electrical men.

Electrical Properties in California.

Electrical properties of the State of California have been assessed as follows: Electric railways, $1,039,491.44; telephone, $399,594.74; telegraph, $25,160.20; gas and electric, 1,224,767.34. The amount of the general corporation franchise tax is placed at $1,676,715.

Peter Junkersfeld.

Success in the central-station business depends primarily, of course, on the kind of men who are engaged in it. The Commonwealth Edison Company, of Chicago, universally conceded to exemplify the ideal in present-day central-station activities, has in the course of its operation assembled an organization of employees that stands without a peer in the electrical industry.

Conspicuous in this organization and contributing in no small measure to the remarkable results being achieved by the company, is Peter Junkersfeld, who for the past two years has been assistant to the second vice-president and for the preceding nine years was in immediate charge of all electrical engineering and construction work on the company's rapidly growing properties.

PETER JUNKERSFELD,
Central-Station Engineer and Executive.

Peter Junkersfeld was born October 17, 1869, near Sadorus, Champaign County, Ill. His parents were Peter J. and Mary Josephine Junkersfeld. He attended school in the vicinity of his home until the age of fourteen and for the next five years worked on his father's farm. At the age of nineteen Mr. Junkersfeld resumed his studies during the winter months only, still working at various pursuits during the spring, summer and fall months, and in 1891 he entered the University of Illinois. He attended this institution for four years, graduating in 1895 with the degree of Bachelor of Science in the course of electrical engineering.

Immediately after graduation Mr. Junkersfeld went to Chicago and a few months later entered what was then the Chicago Edison Company as a helper in one of the generating stations. After two years of operating experience he was promoted to the engineering department and ten months later was made chief draftsman of the company. In 1900, just five years after his connection with the Edison Company, Mr. Junkersfeld was made assistant to the mechanical engineer and in 1906 was given the title of electrical engineer.

In the summer of 1909 Mr. Junkersfeld was made assistant to Second Vice-President Louis A. Ferguson, and with him shares the general supervision of the contract, engineering, construction, and operating departments, employing a total of over 2,600 men.

Mr. Junkersfeld has made an enviable record with the Commonwealth Edison Company and today is regarded as one of the leading engineers in central-station work. During the nine years while at the head of the electrical engineering department, he was in entire charge of the design and construction of the electrical portion of all of the company's power houses which included the extension and reconstruction of several old plants and the building of three new ones. The latter includes the famous Fisk Street station, the earliest example of many electrical and mechanical features now extensively used, the design of which called for the utmost engineering skill and judgment. He was also in entire direct charge of the design and construction of all of the substations built during this period, some thirty in number, which together with the power houses above mentioned, the new Northwest station now nearing completion and the transmission and distribution system, represent the most comprehensive universal power system in any large city in the world.

Mr. Junkersfeld has paid particular attention to alternating-current work, being one of the first engineers to employ a four-wire, three-phase system of primary distribution on a large scale. He has at different times acted in an advisory capacity on several central-station properties including, of course, those now operating in the territory surrounding Chicago. One of the incidents of his career is the work in connection with the widely known railway contracts secured by the Edison Company, by which it has already sold over 100,000 kilowatts to the surface and elevated railways of Chicago. Mr. Junkersfeld was conspicuously identified with these transactions and assisted in working out many of the technical features in an admirable manner.

Mr. Junkersfeld is a member of the Tau Beta Pi, an honorary engineering fraternity, and about a year ago his alma mater, the University of Illinois, further honored him with the professional degree of Electrical Engineer for "distinguished service in his profession." He has also recently been elected president of the general Alumni Association of the University. Mr. Junkersfeld is an active member of the American Institute of Electrical Engineers, the National Electric Light Association, American Society of Mechanical Engineers, Western Society of Engineers, Illuminating Engineering Society, the American Electric Railway Engineering Association, and also the Electric Club of Chicago.

He has made a number of valuable contributions to the literature of the art by papers and discussions before these and other technical societies. He is a member also of the University Club of Chicago, Chicago Athletic Club, Engineers' Club, Westward Ho Golf Club, and the Oaks Club of Austin, a suburb of Chicago, where Mr. and Mrs. Junkersfeld reside.

Physiological Effects of the Electric Current.

The causes of electrical accidents still remain largely uncertain. One individual may be killed by contact with a relatively weak voltage without any evidences on the corpse of the cause of death. In other cases the application of high voltages results only in the amputation of the arms or legs while the victim remains alive.

The only method of securing definite information in this matter lies in vivisection. For a long time it was assumed that the nervous system was very sensitive to electrical currents and the cause of death was sought in the brain and in the spinal cord. Investigation showed only a small clot of blood at this place which was insufficient to account for death. Others have assumed that the cause of death was the cessation of heart-beat. It has been shown by Prevot and Batelli that the cessation of heart-beat may precede or follow the cessation of respiration.

Experiments have been carried out upon dogs by fastening a cup over the artery of the leg and registering the heartbeat by connection of a rubber tube to a registering apparatus. To measure the respiration an incision was made in the wind pipe and a small tube inserted which was connected with a Marey drum. An electro-magnetic device registered the duration of the current. All three quantities were registered on the same cylinder.

The first experiments were made with alternating current at a frequency of forty-two cycles per second. The passage of the current was from fore to rear paw, the heart lying in the path of the current. With 100 volts and 116 milliamperes death resulted in twenty-four seconds through the cessation of heart action. With 1,140 volts and 1.5 amperes a similar result was obtained. With 4,600 volts and 7 amperes the heart-beats did not cease even when the current was connected several times. Burning resulted at the points of contact, but the animal remained alive. When this was followed with an application of 110 volts, death resulted immediately. Using 4,500 volts with a resistance of 90,000 ohms in series the current was reduced to forty-five milliamperes. Each application of the current interrupted respiration, which, however, was resumed when the circuit was broken. When the resistance was decreased so that the current reached a value of ninety milliamperes, death resulted.

These experiments show that a dog is killed by the application of seventy to eighty milliamperes in a path which includes the heart. If the current is too great it will not produce cessation of the heart-beat. The same results were obtained whether the dog was under the influence of an anaesthetic or not. When forty-five milliamperes are used the dog was paralyzed and the muscles cramped. Death resulted after five or six minutes from suffocation. If the current is interrupted prior to this time the animal may be restored to life, but where the heart has ceased beating this is not possible.

When 1,080 volts were applied between the top of the head and the chin, the resulting current being 400 milliamperes, respiration is interrupted but the heart continues beating and the animal lives. If one of the electrodes is transferred to a paw, death results immediately.

To apply these results to the human body it must be remembered that the resistance of the latter with good contacts amounts to 12,000 to 15,000 ohms at 110 volts, resulting in a current of seventy to ninety milliamperes. That such a current may be dangerous has been shown by many practical cases. With 110 volts the results are different according to the personal condition. The effects remain the same where the frequency varies between 10 and 120 cycles.

With direct current the results are the same except that a current strength four times as great is necessary to produce the same effects. In addition direct current produces changes in the muscles which do not appear with alternating-current. The leg of a frog when treated with a certain number of impulses in the same direction experienced a muscular wasting, whereas the other leg after being subjected to twice as many impulses of alternating-current still remained movable.—*Abstracted and translated from L'Industrie Electrique.*

To Improve Chicago Railway Service.

The Board of Supervising Engineers, Chicago Traction, having practically completed the rehabilitation work as prescribed in the ordinance of 1907, has now turned its attention to improving the service on the surface lines, and has made a report to the local Transportation Committee in which the establishment of a number of through routes are recommended, also a change in the routing of some of the cars now operating over certain routes on the north side of the city. For months the board has had men out on the street checking the crowds and gathering information for the above report.

Electrical Show in Los Angeles.

One of the most brilliant electrical expositions ever given in the world will be held in Los Angeles at Fiesta Park from November 25 to December 9, if the plans of the executive committee, selected from the representatives of Los Angeles electrical companies, do not go awry. Plans for the great show were launched at a dinner of the electrical men recently.

The committee selected at a recent meeting consists of H. B. Woodhill, chairman; C. S. Walton, vice-chairman; C. G. Pyle, secretary and treasurer; and J. E. MacDonald and T. E. Burger, associate members. The entire affair will be under the general management of D. M. Moses, who has had charge of similar expositions in other cities.

Fiesta Park is to be protected by a great canopy of waterproof canvas, and the poles will be covered with silks in which vari-colored lights will be embedded. More than 40,000 incandescent lamps will form only a portion of the illumination of the large tent. The 90,000 square feet of space will be divided by avenues and booths in which will be given demonstrations of electrical apparatus.

The railway companies have agreed to decorate their cars with extra lamps during the two weeks of the show, and many business firms of the city will assist in adding special contributions to the brilliant affair.

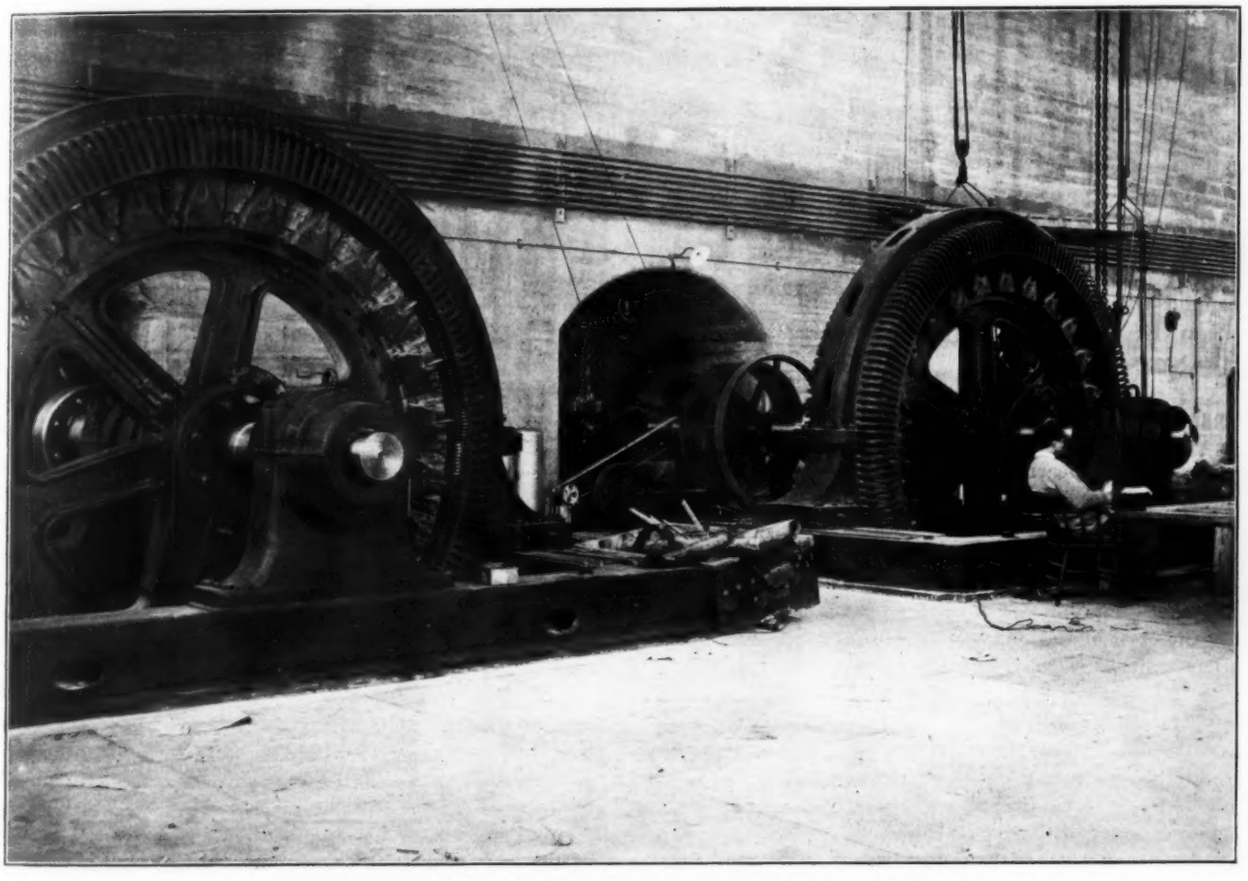
Convention of Georgia Section.

The Georgia section of the National Electric Light Association, which was organized last fall, will hold its first annual convention at Columbus, Ga., on September 26 and 27. Attractive entertainment features, as well as an extensive program of papers, are being prepared. The president of the Georgia section is John S. Bleecker and the secretary is Thomas W. Peters, Columbus Railroad Company, Columbus, Ga.

New Hydroelectric Plant of the Otis Company's Palmer Mill.

Unique Construction Necessary Owing to the Peculiar Conditions of the Plant Site.

The new water-power plant of the Palmer Mill of the Otis Company on the Chicopee River near Three Rivers, Mass., is completed and in operation. This hydroelectric development was an outgrowth of the famous water-rights litigation between the Otis Company and the Ludlow Manufacturing Company, which owns a dam about two miles down the river from the Palmer Mill and transmits the power to the Ludlow Mills. To understand the reasons for the location and design of the present plant it is necessary to touch briefly on the main points that were at issue in the aforementioned law suit.



TWO OF THE 1,000-KILOWATT ALTERNATORS AT PALMER MILL PLANT.

Originally the Palmer Mill derived its power from a pond formed by a wooden dam a few hundred yards above the mill. It owned another privilege about three-quarters of a mile below the mill but undeveloped, although a development was planned.

About ten or more years ago the Ludlow Manufacturing Company acquired ownership of a power site about a mile below the lower site owned by the Otis Company, and proceeded to erect a dam of such a height that it would flood the site owned but not yet developed by the Otis Company, which it was believed would be permissible under the old Mill act of the Massachusetts general court. The Otis Company then exerted itself through its engineers to put into execution its own scheme for developing the privilege it owned but under the ban of the Ludlow Company's plan. As a result the company completed a new hydroelectric station at that point and had it in service for operating its mill for several months before the Ludlow Company's dam and plant was ready to run. The filling of the lower pond flowed out about two-thirds of a nineteen-foot fall and wholly destroyed the utility of the Otis Company's development. A long and ably managed legal contest for damages and rights followed in both the Massachusetts and Federal Courts at Washington, D. C., covering several years' time.

Finally the infringing party paid large damages for its flowage and secured the rights taken, but the Otis Company was without an adequate amount of power for its necessary needs.

The firm of Lockwood, Greene & Company, hydraulic engineers of Boston, was then engaged to advise on a comprehensive plan to utilize the water and river fall that remained. The advice of the engineers was to construct a new concrete masonry dam with a new power house at the foot of the falls or head of the pond formed by the Ludlow Company's dam at a point about 1,000 feet below the Palmer Mill and 1,300 feet above the old dam that was flowed out; and build the crest of this dam to the legal height that the old wooden dam above the mill afforded. This gave a total net head of

27.7 feet as available at one point and enabled the Otis Company to use the entire fall from the level of the old pond to the level of the Ludlow Company's pond. The new power house located contiguous to one end of the new dam was so designed that its wheels could discharge into the pond of the Ludlow Company direct and the excavation of pits was made to such depths that even if this lower pond were drawn off it would not destroy the operation of the new wheel but improve the head under which this operated. The down-stream dam, also the up-stream dam were blown up being now rendered useless by the new development.

The new dam extends diagonally across the river from a feasible ledge point on the north shore to the head-gate section of the power house, which is at right angles to the river flow on the south side. On either bank high rocky ledges made it necessary to build only very short wing walls. The dam itself as well as the wing walls, abutments, and the power-house foundations and floors are of concrete. The roll way is surmounted by permanent wooden vertical flashboards one foot high, equivalent to the flashboard and flowage rights carried by the old wooden dam up-stream. Furthermore the dam was desngned to carry additional removable flashboards two feet in height if it should be desired in the future to increase either the pondage or the head. The abutments and wing walls are carried ten and seven-tenths feet above the crest of the roll way as a precaution against floods. The roll way itself is 190 feet long with an additional twenty feet for a spillway at an elevation three feet above the roll-way crest and thirty-three feet more at an elevation of 3.7 feet above the spillway. The concrete masonry of the dam is ballasted, wherever practicable, with granite rubble, the face, crest, and back of the dam and the walls having a uniform granolithic surface finish. To draw off the pond in dry season if necessary to examine the foundations of the old mill walls, there are provided waste gates in the dam near its base.

The power house is located on the south bank of the river with one wall starting in the channel while for the remainder it was necessary to excavate into the ledge bank. Very little excavation was necessary for the forebay the bottom of which is on a rocky ledge about fourteen feet below the usual water surface. This is also the level of the power-house floor. Across the mouth of the forebay is a log boom which runs diagonally from the south bank to the power-house end of the dam for the purpose of diverting floating drift over the roll way.

The main units in the power house are three fifty-one-inch Hercules twin water wheels manufactured by the Holyoke Machine Company, of Worcester, Mass. Each of these machines is specified to deliver 1,600 horsepower under a head of 27.7 feet. The water wheels are direct connected to 1,000-kilowatt, alternating-current generators which produce current at 2,300 volts, three-phase, sixty-cycles. A separate concrete flume is provided for each pair of water wheels and twin gates in the head-gate wall govern the water supply to the flume for each pair of turbines. The rated speed of the main units is 150 revolutions per minute.

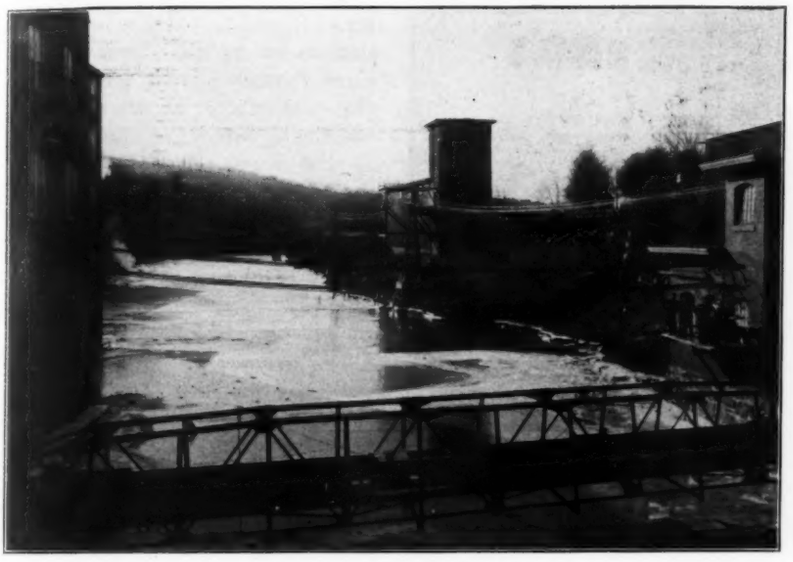
Besides the three main units described above there are two smaller wheels set alongside the main units, and of the same type as the latter. The larger of the two auxiliary wheels is a twenty-seven-inch Hercules twin water wheel rated at 375 horsepower and direct connected to a 200-kilowatt alternating-current generator which operates in parallel with the three main generators. This unit runs at a speed of 257 revolutions per minute. The smaller unit is a fifteen-inch wheel running at 480 revolutions per minute and rated at 110 horsepower. This is direct connected to a direct-current generator which provides current for the excitation of the alternating-current generators and for other uses around the power house. Both the small wheels are served by the same feeder, the water supply being controlled by two gates at the head-gate wall.

The draft tubes are elliptical in shape and formed in the concrete foundation. They are designed to discharge the water from the wheels horizontally down stream at a very low velocity, the discharged water emerging under ordinary conditions below the surface of the down-stream storage pond at less than two and one-half feet per second. The draft tubes were designed with particular reference to protecting the plant from loss of head regardless of what the Ludlow Company should do. Thus if the latter's pond should be drawn the total head on the Otis Company's machines would be increased to thirty feet or possibly thirty-one feet as a maximum. The minimum head which can possibly occur would be twenty-six feet if the Ludlow Company's power plant were idle and the river overflowing its dam. Such a contingency can be met, however, by the use of the temporary flashboards at the Palmer Mill dam.

PALMER MILL HYDROELECTRIC PLANT—HEAD GATES IN FOREGROUND.

A concrete wall separates the wheel pits from the generator room and on top of this runs one rail of a crane track. The other rail is carried on brackets attached to I-beam columns set at a sufficient distance from the concrete wall to enable the fifteen-ton hand crane to handle all generator parts with ease. The bay between these columns and the building wall, used as a switchboard gallery below, is carried above the main roof of

the building in the form of a wire tower from which the transmission line starts. The main roof is carried by a brick wall continued up from the concrete division wall on one side and I-beams carried on the steel columns which support the wire-tower wall and crane rail on the other. Steel trusses support a standard-plank-and-timber roof upon which is laid one layer of sheathing paper and five-ply felt with pitch and gravel roofing.



TRANSMISSION LINE TO MILL.

TYPE OF TRANSMISSION TOWER AT RIVER BEND.

For the excitation of the main generator units there are in addition to the seventy-five-kilowatt, direct-current generator direct-coupled to the fifteen-inch water wheel, one thirty-kilowatt, direct-current generator operating at 125 volts belt driven from one of the large units, and one fifteen-kilowatt, 125-volt direct-current generator likewise belt driven from the twenty-seven-inch water-wheel shaft.

In the bay which constitutes the lower part of the wire tower is the switchboard which contains generator and exciter panels as well as two panels for the control of the outgoing feeders, one panel for each of the two independent transmission lines. This switchboard stands directly on the solid concrete floor of the station and the leads from the generators are carried to the switchboard in shallow-covered trenches in the concrete flooring. Each panel is equipped with the usual set of switches, instruments, plugs, fuses, and other necessary fittings for the control of the generators and feeder lines as well as the lighting equipment of the power station itself.

Station lighting is provided for by a small transformer using current from the alternating-current generators. All wiring for this service is in conduits, also, the cables are run underground to the electric lamps, located above the gate gears and racks over the dam. These lamps consist of four-inch wrought-iron standards set in heavy cast-iron bases and carry ten-inch globes with marine receptacles.

All machinery of the mills is now operated by electric motor since the old wheels and auxiliary engines have been dismantled and removed.

Austrian Technical Museum.

The Technical Museum in Vienna publishes a circular stating that, in commemoration of the sixtieth anniversary of Emperor Francis Joseph's reign, Austrian manufacturers with the assistance of the State and the City of Vienna initiated this new Museum. The foundation stone was laid on June 20, 1909, and the building which covers an area of over 20,000 square yards and which is situated opposite the palace of Schoenbrunn, is now nearing completion.

This Technical Museum is to demonstrate the development of industries and crafts in historical succession, also to do justice to the technical achievements of the present day, and to promote progress in this line by periodical exhibitions. It is to be a public educational center, spreading the knowledge of the scientific foundations and the national-economic aims of technical pursuits.

A considerable stock of objects has already been secured, as several large and valuable State collections, till now dispersed, are shortly to be brought together there. But many links in the chain of techinical development are still missing. Therefore technical scientists, manufacturers and craftsmen of all countries are invited to cooperate in this great task and to assist the Museum in procuring and selecting suitable objects. Everything pertaining to technical labor is acceptable. The names of donators will be perpetuated by inscription on the gifts and in a memorial book.

Further particulars can be obtained from the office of the Technical Museum, Ebendorferstrasse 6, Vienna.

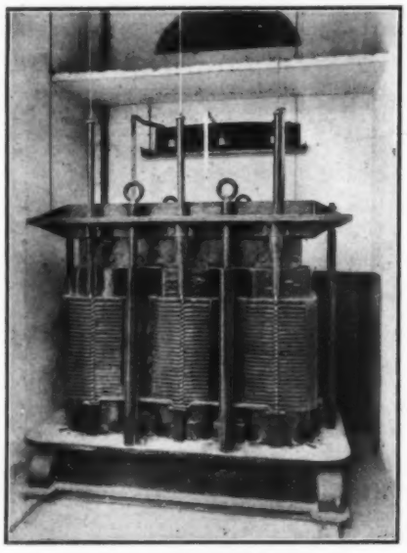
THE CERVARA GENERATING STATION.

BY C. L. DURAND.

The Valnerina Electric Company, of Italy, is now operating a hydraulic plant of some size from the water of the Nera River, which is located in Central Italy and is a tributary of the Tiber. The plant operates in connection with an electrochemical works lying some miles off. Current is sent from the turbine plant to the works, which is mainly devoted to carbide manufacture, over a 27,000-volt power line. A second power line is also operated at 3,750 volts for the local lighting of the town of Terni. The present plant replaces an old station which was erected on the same site. From a dam across the Nera River the water is led by a double flume of 1,700 feet in length and 117.3 square feet cross-section into the settling basin which is shown in the accompanying illustration, lying next to the turbine house. Six penstocks are provided for the principal turbines of the plant, together with two smaller ones for the turbine groups retained from the old station, also two penstocks for the exciters. The head of water is about 66 feet and the main penstocks are 7.5 feet diameter.

All of the electrical outfit of the Cervara plant was installed by the Oerlikon firm of Switzerland, from whom the following data were obtained about the principal station, the power line and the substation at the carbide works lying at Narni.

The general arrangement of the Cervara project will be noticed in the view of the plant and basin, the plant interior being shown in another illustration. Foundations are provided for the six principal 2,000-kilowatt turbine-alternator sets, and five of these have now been installed and will be seen in the foreground. Each unit is provided with a separate turbine. Next to these groups are two 865-kilowatt alternator sets belonging to the old plant, each with a smaller turbine, and in the rear are the two exciter groups.



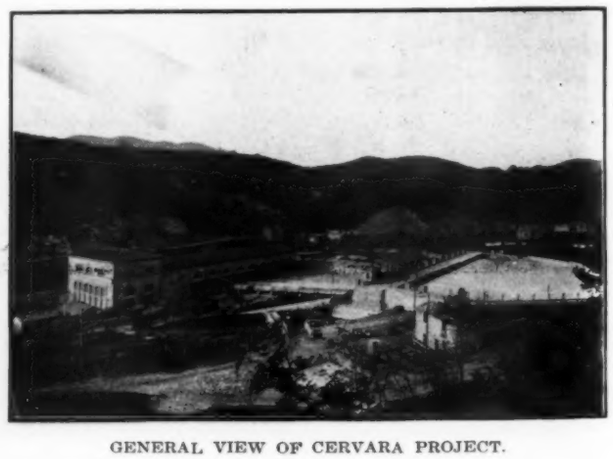
TRANSFORMER IN CELL.

The main alternators are coupled to 2,200-horsepower double-reaction turbines of Italian make, built by the A. Calzoni works of Bologna. Under a head of water varying from 63.2 to 76.7 feet, according to the season, these wheels take from 1,900 to 2,266 gallons of water per second to give the above power. The alternators themselves are of the Oerlikon type and are built for 3,750-volt, three-phase current at a standard speed of 252 revolutions per minute at forty-two cycles. They have a revolving twenty-pole field wound with copper strip and an external slotted armature of the usual slotted-ring form.

For the exciters there are used two seventy-five kilowatt generators each coupled to a small turbine, and operating at from 120 to 145 volts at 500 revolutions per minute. Each of these sets gives enough current for exciting all the alternators of the plant. An additional reserve group is installed in the shape of a 240-horsepower, three-phase motor-generator set. The motor is driven from the 3,750-volt busbars of the plant and is operated at 500 revolutions per minute. It delivers 120 to 150-volt direct current to the exciter busbars.

In the annex, which lies against the main building, the switchboard apparatus, such as busbars, transformers, instruments, etc., is placed for the most part in cells built of concrete so that all the pieces of apparatus are kept well separated. The switches and different connections for the alternators are placed on the lower floor, while the marble panel board is mounted in a gallery so as to overlook the machine room. In general, the circuits of the plant are laid out so as to operate the principal power line running to the electrochemical works at 27,000 volts, together with a local line at 3,750 volts, which supplies Terni with current for the uses of the town. Accordingly there is a set of low-tension, 3,750-volt busbars and a second set of 27,000-volt bars, these latter being supplied by the step-up transformers of the plant. The low-tension busbars with their apparatus occupy the rear side of the marble board and are lodged in a

MAIN SWITCHBOARD PLATFORM.



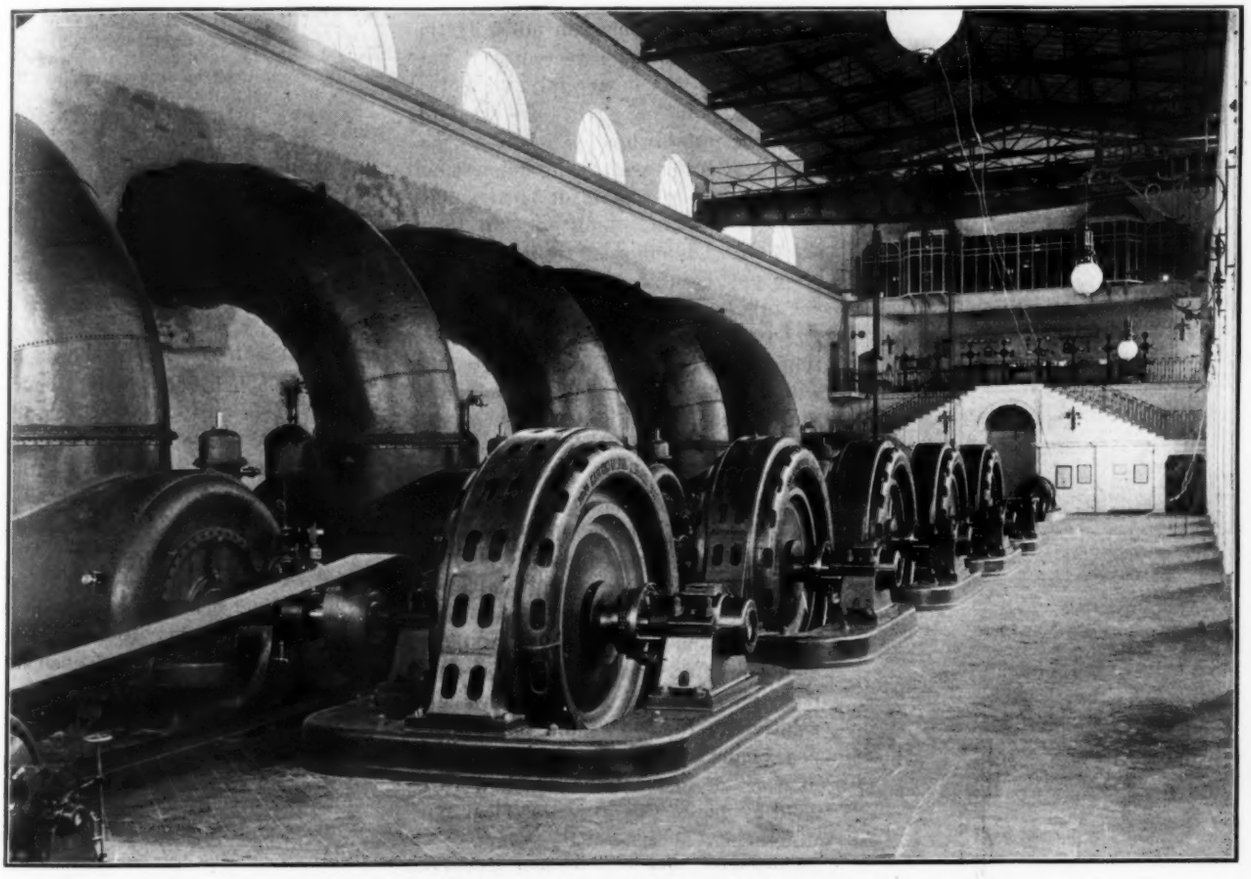
GENERAL VIEW OF CERVARA PROJECT.

set of cement cells. From here the connections are made to the 3,750-volt power line at the top floor, and other circuits run directly across the back of the switchboard so as to connect with the secondaries of the transformers. One of the illustrations represents the Oerlikon three-phase transformer of the air-cooled type which is used here. Each unit is housed in a separate cement cell, and there are in all six cells. At present, five transformers are installed, each of 1,900-kilowatts capacity with a 3,750 : 27,000-volt ratio. The three coils of the transformer are coupled in star, with the low-voltage coils on the inside and the 27,000-volt coils outside, separated by prepared paper and mica insulation which projects out beyond the ends of the coils so as to give good protection. As an air draft coming from a flue under the floor is used for the cooling, the coils have a sheet-iron jacket around them (here removed) which gives the proper circulation of the air. Two ten-horsepower Sulzer air fans are used for the purpose.

A special room lying above the transformers is used for the 27,000-volt, three-pole switches and this, like all the high-tension part of the plant, is laid out according to the most recent practice. Each of the three-pole switches occupies a specially built cell and each of these lies quite apart from the adjoining ones. The switches are designed to work by magnet action upon overload and are also provided with means for hand operation. For this latter use, a sheave carries a steel cable which runs down to the operating post in the switchboard gallery.

On the same floor and in an adjoining room are the 27,000-volt busbars. Two separate sets of bars are used, and one of them serves as a reserve. Switches are provided for connecting the transformers or the power lines to one or the other set of busbars as may be needed. The apparatus for the power lines leaving the station is mounted on the top floor of the building. Considerable attention has been paid to equipping the principal 27,000-volt power line with lightning-arresters and other protecting devices, and these are of a very recent design. The power line carries six wires or two per phase, and on each wire is a lightning-arrester and a new type of water resistance, which are shown in the lower sections of the 27,000-volt compartments.

The marble panel board and the operating columns which are mounted in front of it are well shown in the illustration of the main gallery. The panel board is used for the line instruments while the columns serve for the machines and low-tension transformer circuits and carry operating levers and wheels. Each alternator has one column, which carries the measuring instruments as well as two levers, one used for the alternator switch and the second for the transformer switch. One of the hand wheels serves for the exciter rheostat and the second for the switch of the exciter. Interlocking for the alternator and transformer switch is provided so as to prevent any mistakes in operating.

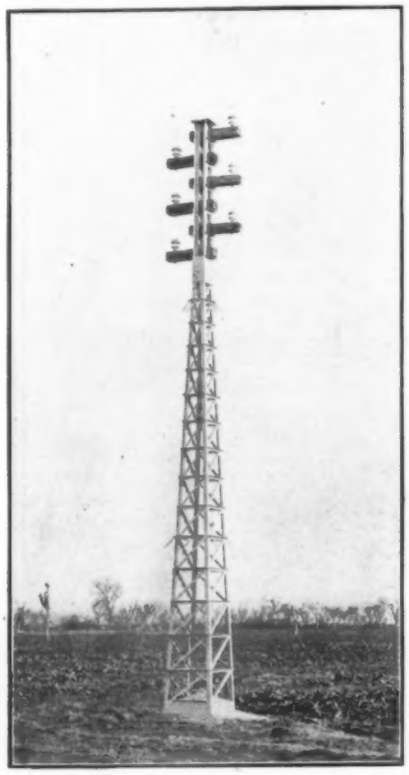


MAIN GENERATING ROOM, CERVARA HYDROELECTRIC PLANT.

The 27,000-volt power line which runs to the carbide plant of the company is mounted on structural iron poles. Its total length is about 8.6 miles and it is made up of six wires of 7.2 millimeters (0.29 inches), the wires being spaced 90 centimeters (35.1 inches) apart and

mounted on Richard-Ginori insulators of Italian make. Wood cross-bars are used. The line uses this type of metallic pole as a standard for most of the length, and a 100-meter (328-foot) span is adopted. The height of the lowest wire above ground is 9.30 meters (30.5 feet) at the pole and 7.25 meters (23.7 feet) at the middle of the span.

A transformer building of some size is erected at the carbide plant at Narni in order to receive the line. It has three floors for the various line apparatus and on the ground floor is a separate room for the Oerlikon transformers, placed in



TRANSMISSION TOWER ON THE 27,000-VOLT LINE.

a set of cement cells. The secondaries of the transformers furnish 500-volt current for use with the carbide furnaces, and these are installed in the adjoining building.

Wireless Weather Signals.

For some time the French Government has sent out regular time signals at 11 o'clock in the morning from the Eiffel Tower in Paris. This is now made of still more use to mariners by being followed by a series of meteorological signals, reporting the height of the barometer and the direction and force of the wind and the roughness of the sea at a number of Atlantic stations.

THE A. B. C. OF THE TEST DEPARTMENT.

BY F. W. HERLAN.

The testing of motors and generators is an operation wherein valuable product can quickly and easily be reduced to scrap value by the omission of a few simple and necessary precautions, and it is not so much the purpose of this article to present the reader with a technical treatise of the various methods used on the test plate, as it is to draw attention to a few of the salient points which should be borne in mind by the man who is testing direct-current machines from a commercial and not a technical point of view. In a manufacturing establishment, when a machine leaves the assembling department to go to the test plate, it is presumed to be in working condition, but there are quite a number of things that are often not discovered till the test is well begun. In many of these cases there is no need of this, as a little careful inspection before the machine is started up will discover most of the mechanical faults if there are any, and other faults can be located by methods which will be described.

Another thing that costs the "Company" money is the careless and rough usage of instruments and the writer has seen things done that would lead one to wonder if there were any common sense at all in some individuals. As instruments are a necessary part of every test it seems advisable to give a few notes relative to their use, and nothing appears more appropriate than a summary of a set of instructions which were issued by one of the large electrical manufacturing concerns to its testers.

SUGGESTIONS FOR THE PROPER HANDLING OF INSTRUMENTS.

In General.—Handle all instruments CAREFULLY.

Always use instruments of the proper capacity.

See that all needles are at zero when starting.

Have all leads FASTENED to the test table to prevent instruments being pulled to the ground.

Cables carrying moderate or large currents should NEVER be run in close proximity to instruments.

All permanent-magnet instruments should be kept as far apart as possible when taking readings.

On General Electric Company's astatic instruments, exciting coil should be kept constantly excited.

Cultivate the habit of disconnecting instruments as soon as a reading is completed. This eliminates heating error and also other things.

Voltmeters.—Do not allow leads to touch cover, as one side of the circuit is permanently grounded in the instrument.

Do not use lamp cord or other stranded cable for leads unless the ends are provided with suitable copper terminals.

Be careful when changing leads from one scale to another that they do not touch the case.

Never connect first to the source of potential, leaving the live ends to be subsequently connected to the voltmeter.

Never disconnect leads from the instrument until the circuit has been broken.

Keep on the high scale as much as possible.

In starting to read a low voltage take a preliminary reading on the high scale.

After taking a reading on the low scale ALWAYS move leads back to the high scale. This precaution will save seventy-five per cent of your burnouts.

In measuring the resistance of any inductive circuit, such as a transformer of the shunt field of a dynamo by drop method, never break the current circuit without previously disconnecting the voltmeter. The inductive kick will do some damage.

Ammeters.—Always protect the instrument with a short-circuiting switch.

Never connect or disconnect the instrument unless this switch is closed.

Never start up a motor with an ammeter in circuit. Be sure the short-circuiting switch is closed otherwise the high starting current may injure the instrument.

There are other instructions relating to wattmeters, tachometers, etc., but as they relate to some specific make they have been omitted. When a tester is to use some such instrument, he should always make it a point to receive full instructions as to its working points before he attempts to use it. With the above points thoroughly in mind, the tester is analogous to the budding mechanic who has learned the things he should and should not do with his tools, the next thing being to learn something about the actual work upon which he is to expend his energy. It has been stated above that a little careful inspection before a machine is started up will discover many faults if they exist.

For instance, an examination of the commutator should be made to see that it is clean and that there are no obviously high or low bars. The brushes should then be examined to ascertain if they are properly fitted; the brush holder should move freely when the clamping screws are loosened; and cases are not uncommon where the brush holders and field leads are found to be fouling the armature. The inside connections should always be checked and care taken to see that they are all tight. The journal boxes should be filled with oil if this has not already been done and an inspection made for leaks. See that the pulley is secure and that all nuts and bolts are tight. As a final precaution, in the case of new machines, check the nameplate and see that the stamping agrees with the specification.

All of these features should of course be attended to by the inspector before the motor or dynamo is allowed to leave the assembly department, but inspectors are human and liable to overlook a number of points which they should catch and for this reason the tester will do well to spend five or ten minutes investigating.

It is sometimes impossible to discover any unevenness at the initial inspection of the commutator when the machine is stationary and it is therefore advisable to make a further examination when the machine is running. The usual method of procedure is to hold a sharpened lead-pencil lightly on the surface of the commutator. If there are any rough spots, high or low bars, there will readily be detected by the vibration of the pencil. In cases of slight unevenness the trouble can sometimes be overcome by the use of coarse sandpaper, but emery paper or cloth should never be used as the carbon dust will cause short-circuiting of the commutator bars. Where a high or low bar is encountered the armature must be removed and the commutator re-turned. In central stations or power plants it occasionally happens that an uneven bar will develop due to one of several causes and in such cases it is often inconvenient to remove the armature. Under such circumstances a rig may be built on the frame of the machine and the commutator turned in its own bearings. This should, however, never be done by the inexperienced as it is liable to cause more trouble than that first encountered.

An important feature is the checking of the armature, first to see that it is properly balanced, and secondly that it is magnetically central. Before attempting this be sure that the machine is perfectly level. If there is any doubt about it the pulley should be removed and a check made with a spirit level on the shaft. If the armature is out of balance there will be excessive vibration, which can easily be detected by placing the hand on the frame, particularly at the feet of the machine. Vibration will also be caused if the shaft is sprung and in either case the armature must be taken out and the fault remedied.

In checking the magnetic center, take a small block of wood and when the machine is running press with it on either edge of the rim of the pulley. If the armature is central it will oscillate back and forth when the piece of wood is removed; if not the thrust collars will hug one bearing or the other. When making this check on a generator the machine must be run as a motor for the time being. The only remedy if this fault is found to exist is to remove the armature and have its position changed in relation to the shaft.

After an inspection of the journal boxes, to insure that the oil rings are turning and carrying oil in a proper manner, the testing can be proceeded with. Should the boxes show signs of becoming excessively warm see if the belt can be loosened a little and still carry the load. Sometimes it is advisable to draw off the oil, which may have become gritty from sand in the oil-well casting and fill up with fresh clean oil.

FAULTS LIKELY TO BE ENCOUNTERED WHEN TESTING MOTORS AND GENERATORS.

Failure of Motor to Start.—This is generally due to one or more of the field spools being reversed and can be checked in the following manner. The field should be excited at its normal or a lower voltage and then after breaking the exciting current the polarity of each pole should be checked with a compass. It is advisable to open the exciting circuit before checking as otherwise the needle of the compass is liable to be reversed. If the machine is properly assembled the poles should alternate north and south. If the armature has not been given the proper lead there is a liability of the machine failing to start when the current is applied. This can be checked by moving the brushes round until a point is found where the armature will rotate. Care should be taken on a motor in which this trouble occurs to see that the ammeter is properly protected as failure to start causes excessive current to flow when the armature circuit is closed through the rheostat.

Wrong Rotation of Motor.—The first thing to be noted when the machine is started is the direction of rotation. Although the connections have previously been checked it is often possible that the field spools have been assembled with the winding in the wrong direction and this cannot be observed upon a visual checking, or the armature windings may not have been given the proper lead, either of which faults may result in wrong rotation.

Short-Circuited Motor Armature.—This can generally be detected by a burnt smell issuing from the machine, due to the heating of the defective coil. It can readily be found by shutting down the motor and passing the hand over the armature coils. Another way of detecting a short-circuited coil is to hold a small piece of iron or steel in the hand between the pole pieces near the armature when the machine is running. The piece of metal can be felt to vibrate in the hand due to the distortion of the magnetic field on account of the excessive current in the short-circuited coil. The free readings on a motor that has a short-circuited coil will be abnormally high.

Open-circuited Motor Armature. — This can readily be detected by quite a long spark at the brushes and a blackening of the commutator segments connected to the defective coils. This blackening of the segments is due of course to the continuous flashing when the defective coil passes under the brush.

Excessive Field Current in Motor.—This is generally due to one of the spools being short-circuited or to one or all of these spools being wound to a wrong specification. By taking the resistance by the drop-of-potential method across each individual spool the faulty one or ones can be located.

Sparking at Commutator of Motor.—Excepting where above mentioned this is due to wrong lead of brushes, high or low bars, rough spots, or bad fit of brushes.

Flashing Over.—This is generally due to wrong lead of brushes, excessive overload, or too weak a field.

Short-Circuited or Open-Circuited Armature on Generators.—Either of these faults can be detected in the same way as on a motor.

Failure of Generator to Build Up.—If a machine is found that will not generate it is liable to be due to one of the following causes and the tester should proceed as follows to locate the trouble: On shunt machines first be sure that the generator is running in proper direction of rotation and also that the field circuit is closed through the rheostat. If these points are found to be correct and the generator will not build up, put a "jumper" across the terminals of the rheostat which, in case the rheostat is open-circuited, will allow the generator to build up if there is no other trouble. If the machine still fails to build up see that the commutator is clean and that the brushes fit properly. If this does not

prove successful open the field circuit and connect the voltmeter across the terminals of the armature. A small deflection, due to residual magnetism, will be obtained. Now close the field circuit and if this deflection tends to decrease it shows that the current generated in the armature is in a direction to oppose the residual field. If such is found to be the case, reversing the field or armature leads should cause the machine to build up. The same instructions practically apply to compound generators. If when the load is applied the voltage drops it shows that the series field is in opposition to the shunt and that the generator is wrongly connected.

The foregoing troubles are the more common ones which will be met with. Others, such as motors failing to come up to speed, running too fast, etc., cannot be remedied by the tester, as the fault is usually inherent in the machine itself and necessitates shimming, changes in the winding, or other such remedies and as the title implies it is not the purpose of this article to go beyond the fundamentals. The various commercial, every-day tests will now be described.

SHUNT MOTORS.

Resistance of Fields and Armature.—The former is taken by the bridge method and should be measured before the machine has been run at all. The latter is often called for by the engineering departments for statistical purposes to aid in design calculation and should be obtained by measuring the drop in potential as follows: Remove the carbon brushes and substitute copper brushes with pointed ends so that only one segment of the commutator is in contact. On multipolar machines leave out the bottom brushes and use top pair only. When the copper brushes are in place a prick-punch mark should be made on the outer edge of the segment on which each brush rests, but this must be done very lightly otherwise a low bar will result. These marks are used to definitely place the voltmeter leads, which should be fitted with sharpened points. This method eliminates any drop which might otherwise occur owing to poor contact and the voltmeter should never be connected in any other way.

When the current is applied there is a tendency for the armature to rotate due to the fact that a field is induced and it is therefore sometimes necessary to insert wedges between the pole pieces and the armature to prevent this rotation and consquent burning of the surface of the commutator. When this has been done the armature may be connected to a low-potential circuit.

As near the full-load current of the machine as possible should be used when taking the readings and a suitable ammeter is therefore necessary. As has been previously stated, this ammeter should always be protected by a short-circuiting switch, which should only be opened when everything is found to be all right. The voltmeter switch should always be kept open till the circuit is closed and opened before the circuit is broken. This is a case where the precaution is necessary due to the fact that the instrument is liable to injury from an inductive kick from the armature when the circuit is open. Four or five readings should be taken with a slight change in the current value at each reading, the resistance calculated by the formula, $R=E/I$, and the mean taken.

Free Readings.—We now come to what are known as the "free readings" taken both hot and cold. The first precaution when taking cold readings should be to see that any wedges used for the resistance measurements are removed and secondly, always be sure that the field is excited before the armature circuit is closed. When taking these readings the pulley that is to be shipped with the machine should be on.

The current to be read in this test is generally low and a milliammeter can be used in the majority of cases for reading the armature and field currents. A meter scaled up to five amperes will usually be sufficient for small machines and a fifteen-ampere meter for the larger motors.

It is the usual practice to check the balance and end play (magnetic center) of the armature during this test, as the free running condition is an essential of all the information required. The brushes should of course be set at the neutral point, *i. e.*, when the machine will run at the same speed either clockwise or counterclockwise.

The more important function of the test is the heat run and one method of carrying this out is as follows. A generator that will give the necessary load should be carefully lined up with the motor under test. Pulleys that will allow the motor to run at its rated speed and the generator to give the requisite output should be used and the belt adjusted as loosely as possible to carry the load without coming off. The generator should now be loaded up on a water rheostat and the load roughly fixed, the finer adjustment being made with a rheostat in the field of the generator. This adjustment should be made gradually until the desired load on the motor is obtained. The load must be kept constant during the run and frequently checked. Never have a resistance in the field of the motor, unless demanded by the designing engineers for some specific purpose.

Readings of the line current, field current, volts and speed should now be taken. After these have been recorded the ammeter should be short-circuited and the voltmeter taken out of the circuit. Readings should be taken throughout the test at intervals of not more than ten minutes. The commutator and bearings should be watched carefully throughout the entire test. A little vaseline applied to the commutator with a cloth at the beginning of the run will tend to insure good running surface.

At the end of the test a neutral point for clockwise and counterclockwise rotation at loaded speed should be marked on the brush yoke. Free hot readings should then be taken in the same manner as the cold readings. The resistance of the field and armature should then again be taken the same as previously and the percentage rise calculated.

The insulation-resistance test is now made usually with a potential of 500 volts, one megohm (one million ohms) being the lowest which the machine should be allowed to pass on. This resistance is taken as follows. A pair of leads is run from the 500-volt circuit, one going direct to the frame of the machine, the other to one side of the voltmeter. From the other voltmeter terminal, have a loose lead to connect to the armature or field terminals. There will be a slight deflection on the voltmeter showing the leakage between the winding and frame, which deflection should be carefully noted. Now join the lead that is on the frame to the one which was applied to the armature and field terminals, in this way attaining the line voltage. The resistance of the voltmeter must be known and then the following formula for obtaining the insulation resistance may be applied, the final result being in ohms:

$$R=(E_1-E_2)r/E_2$$

where E_1 = line voltage, E_2 = leakage between winding and frame, r = resistance of voltmeter, R = insulation resistance.

Heat Run by Hopkinson Method.—This method is used to save power and in

addition to being called the Hopkinson or motor-generator method it is sometimes referred to as "pumping back." It is generally used on two machines of the same voltage, horsepower and speed, and in this case the pulley should be of the same size. Machines of the same voltage and horsepower but where the speeds are different can also be run in this manner by using pulleys which when driving each other will give their rated speed.

The test is made with both machines connected to run as motors and they are then belted up. One machine is started while the other has all the switches leading to the circuit open. The field switch on the latter machine is then closed. This excites the field and causes the machine to generate. The voltage will be found to read slightly less than the line voltage and can be raised by inserting a field rheostat in the motor and slightly increasing the speed by weakening its field. Great care must be taken to have the voltages of the machines "buck" against one another, otherwise a bad short-circuit will be the result. If the polarities are correct, the main switch is closed.

All ammeters in the circuit must be kept short-circuited until the switch is closed. The load on the machines can be increased by weakening the field of the one which runs as a motor, this speeding up the machines and tending to make the voltage of the generator higher than the line and in this way causing more current to flow. Motors run in this way must be very carefully watched and the load often checked. This method of taking heat runs should be used wherever possible as it saves considerable power. Fig. 1 illustrates the method of wiring the Hopkinson test.

SERIES MOTORS.

Measurement of Resistance.—The resistance of the field of a series motor is taken by the drop-of-potential method, although there will probably be cases of small motors where the resistance is high enough to be taken by bridge. The same general directions may be followed as on shunt motors both for the armature and fields. The voltmeter leads should always be run directly to the field terminals of the machine when taking readings by the drop-of-potential method.

Free Readings.—Free readings of course cannot be taken on a series motor on acount of its very high speed under these conditions and the liability of the moving parts bursting.

Heat Run.—The same general instructions may be followed as on shunt motors. When readings are taken the load should be absolutely correct, otherwise erroneous speeds will be obtained. The neutral point is fixed at the beginning, and checked at the end of the heat run the same as on shunt motors. The Hopkinson method cannot be used to good advantage on series motors.

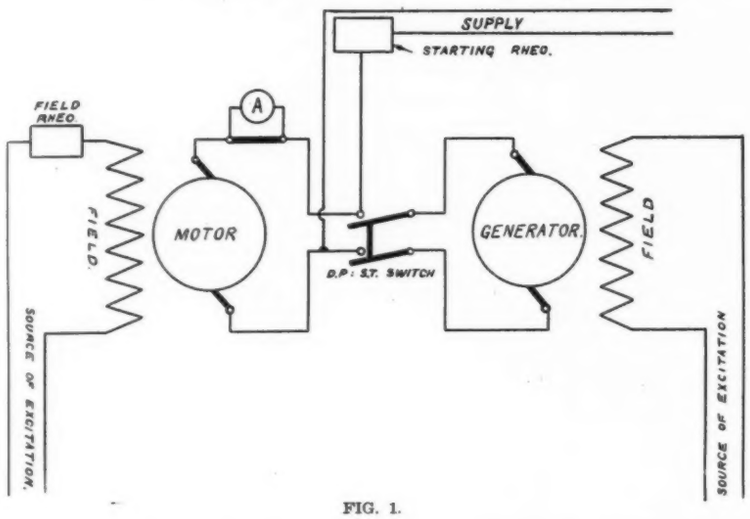


FIG. 1.

COMPOUND WOUND MOTORS.

Free Readings. — Instructions for shunt motors hold good for compound-wound machines. When the shunt field has separate terminals the neutral point for the brushes may be obtained in the same manner as on shunt motors except that the armature leads are reversed to change the direction of rotation.

Heat Run.—Here again the instructions as given for shunt motors may be followed. Motors of the same size, etc., can be run by the Hopkinson method, leaving the series fields in circuit and following out the same general directions for running as on shunt motors. Quite often compound-wound motors can be run by the Hopkinson method with shunt motors by obtaining the correct combination of pulleys. Compound motors are generally internally connected so that when the load is applied the speed drops due to the action of the series field helping the shunt field. This point may be noted by observing the no-load and full-load speeds as given on the nameplate. In some cases compound motors are built where the speed increases when the load is applied. In the former case the motor is said to be connected "cumulatively" and in the latter "differentially."

SHUNT GENERATORS.

Resistance Measurements.—The same instructions may be followed as on shunt and series motors.

No-Load Readings.—Generators should always be driven by motors plenty large enough to carry the full load of the machine under test and suitable rheostats should be at hand to insert in the motor or generator fields, the motor rheostat being used to obtain good speed regulation and the generator rheostat to allow the voltage to be varied. When the correct speed of generator has been obtained the no-load readings should be taken,

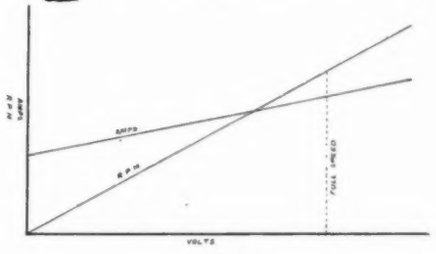


FIG. 2.

these consisting of "armature volts," "field volts," "field amperes," and "speed." After adjusting the voltage of the generator by its field rheostat, always give it a little time to become constant. Care should be exercised in the selection of instruments to see that they are of ample capacity.

Heat Run.—The same instructions may be followed as on shunt motors and always be sure to keep the load constant throughout the run.

COMPOUND-WOUND GENERATORS.

Resistance Measurement and No-Load Readings.—The resistance is obtained in the same manner as on shunt and series motors and the no-load readings as on shunt generators.

Heat Run.—The same instructions may be followed as on shunt generators, excepting that a temporary shunt is

placed across the series field during the run to shunt approximately the normal current from it in order to obtain the rated full-load voltage of the machine. The final adjustment of this shunt is made at the conclusion of the run. Always be careful to have the load correct, watch the speed carefully, and allow plenty of time for the voltage to become constant before taking readings.

Compounding.—The throwing on of the load on a shunt generator is accompanied by a drop in the terminal pressure; with a series machine the opposite is the case. A generator having a series and a shunt winding on the poles of its field will therefore give an intermediate result, that is, a constant potential at its brushes. A machine designed to give this result is said to be compounded, and one designed to have the terminal volts rise within certain limits is said to be overcompounded. Sometimes the expression "flat compound" is used to signify that the field has been so adjusted as to give approximately constant potential at all loads. This compounding is effected by means of a German-silver shunt placed across the series-field winding thereby shunting part of its current. This is adjusted so that the series field is weakened until the desired degree of compounding or overcompounding is reached. The final adjustment should be made immediately after the heat run while the generator is still warm.

When compounding a machine the tester should proceed in the following manner. Close the shunt-field circuit of the generator and adjust the speed by varying the field rheostat in the motor field. When the speed is correct adjust the generator voltage to the no-load rating. The full load may now be put on the machine and after again checking and regulating the speed adjust the German-silver shunt across the series field so as to give the correct full-load voltage. The commutation should be carefully noted. Do not change the position of the field rheostats on the generator while these readings are being taken as this will vary the strength of the shunt field and render the readings valueless. Intermediate readings between no load and full load should be taken. The German-silver shunt should always be large enough to carry its current without excessive heating and should never be so hot that the hand cannot comfortably be held upon it.

The foregoing practically covers the field of every-day testing which the operator may be called upon to carry out, but before closing it seems advisable to say a few words in regard to efficiency tests, as when called for they are of the utmost importance.

The efficiency of a motor may be obtained by three methods, namely: the brake test; the separate-loss method, and the Hopkinson method, this being used however only when two identical machines are available. With generators the separate-loss method is usually employed.

Brake Test.—The apparatus required to make this test consists of a friction brake, a steel-yard to measure the torque, a tachometer, and an ammeter and voltmeter. Four operators are required, the first to keep the load due to the brake steady so that the arm of the steel-yard is kept constantly in floating equilibrium; the second keeps the voltage exactly constant; the third takes the speeds, and the fourth reads the current.

The necessary observations having been made, the following formulas may be applied.

Output in Watts=Torque × r.p.m. × 6.28×746/33,000. (1)

Input in Watts=Volts×Amperes (2)

Dividing (1) by (2) gives the efficiency. This is a difficult test to perform with accuracy although it is the most direct of all methods.

Separate-Loss Method.—This is a very favorite form of efficiency test and one which gives a high degree of accuracy. A direct-current machine has three prinipal sources of loss consisting of: the armature copper loss, the shunt copper loss and the no-load loss including eddy currents, hysteresis, friction and windage.

These losses may be taken either hot or cold, and it is therefore necessary to distinguish between the hot and cold efficiencies although the former is that usually required. The test is carried out by first loading up the machine for a few hours so as to get it thoroughly hot, then measuring the shunt resistance and the armature resistance, and finally taking the readings of the armature current and speed for different voltages from zero to full voltage or twenty-five per cent higher, in the case of a generator running it as a motor for the time being.

The readings obtained should be plotted as shown in Fig. 2 and it will be found that both curves are straight lines. The product of the amperes and volts corresponding to the full-load speed gives the combined eddy current, hysteresis, friction and windage losses at that speed. The armature and shunt I^2R corresponding to full-load current should now be calculated and added to the output and no-load loss, the sum of these being the input. Dividing the output by the input we have the efficiency.

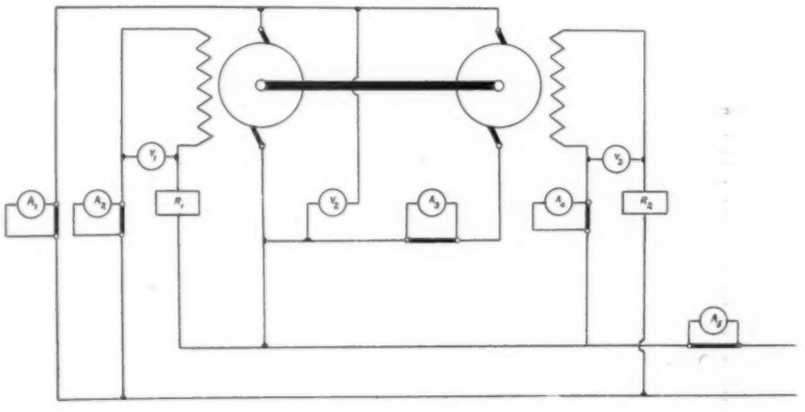


FIG. 3.

Hopkinson Method.—As previously stated this test requires the use of two identical machines and consequently is seldom used. It shares with the separate-loss method the peculiarity of measuring the losses directly instead of measuring the input and output, which of course contributes greatly to its accuracy, as, for instance, nine or ten per cent in the losses involves only about one per cent error in the efficiency.

To carry out this test the machine should be connected as shown in Fig. 3. The two machines should be rigidly coupled together mechanically and the armatures connected so the brushes of like polarity are on one line. An ammeter is placed in series with the armatures and the voltmeter across the brushes. The armatures and fields are connected in

parallel across the line and a rheostat set in each for purposes of adjustment.

If the fields of the two machines are exactly equal they may be considered as two shunt motors in parallel running free and each of them will take half the current flowing through A_1. If by means of the rheostats R_1 and R_2 the fields are caused to differ in strength a short-circuit current will be made to flow in the local circuit around the two armatures equal to $(E_1—E_2)/R$ where E_1 and E_2 are the electromotive forces generated by the two machines and R is the resistance of a local circuit. When R_1 and R_2 have been adjusted to give full-load current in the local circuit it will be found that the reading of A_1 has increased till it measures (when multiplied by the reading of V_2) not only the no-load losses of the two machines as it did before but also the armature copper loss.

The shunt losses may be determined from the readings of V_1 and A_2 and of V_2 and A_4.

Only one rheostat is really necessary to weaken the field of one of the machines and as only a small resistance is necessary (sometimes *very* small) it is usual to neglect the loss in it. In this case the only instruments required are the ammeter A_2 to determine when full-load current is obtained in the local circuit, the voltmeter V_2 and an ammeter A_5 in the line. The latter measures the whole of the current entering both machines and the product of its reading into V_2 gives the total loss, not only in both machines but in the field rheostat as well.

There are occasions when it is either impossible or extremely inconvenient to rigidly mechanically connect the two machines and in such cases they of necessity have to be belted, but the results are much less accurate on account of the belt losses.

The whole of the above written matter contains knowledge which is absolutely essential to the man on the test plate and if these fundamentals are thoroughly absorbed much wasted time, trouble, and spoiled apparatus will be obviated.

Flatiron Sales.

It is estimated that no less than 250,000 electric flatirons were sold in the United States and Canada last year. There are more than 10,000,000 homes within central-station territory, of which fewer than 2,000,000 have electric service; consequently the estimated sales last year approximate one iron to every eight homes.

AUTOMATIC CIRCUIT-BREAKERS.

BY STEPHEN Q. HAYES.

In the modern power house, one of the most important items to consider is the means by which the apparatus installed can be protected from short-circuits, grounds or overloads on the line, or similar conditions that have to be guarded against. To meet such conditions, circuit-breakers of various types have been designed to open instantly or after a certain time upon the occurrence of certain predetermined conditions.

The principal demand is for circuit-breakers which will open the circuits when the current reaches a certain predetermined value, and breakers are designed with this end in view as well as for underload conditions to open on

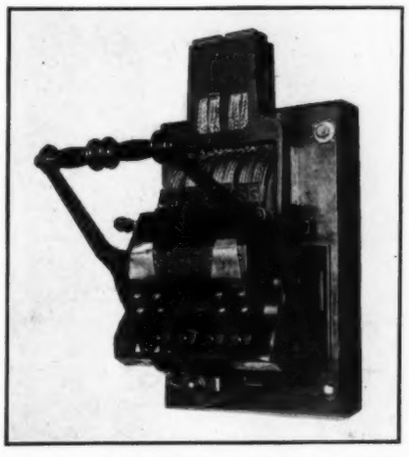


FIG. 1.—14,000-AMPERE HAND-OPERATED CIRCUIT-BREAKER.

minimum current, for over-voltage to open when the voltage exceeds a certain amount, for under-voltage to open when the voltage falls below a certain minimum value, for reversal when the current flows in the opposite direction through the breaker from that which was intended. It is, of course, possible to combine these various features of overload, underload, reversal, etc., in one and the same breaker.

When any circuit-breaker, or other switching device is opened while carrying current, the tendency is to draw an arc at the point where the circuit is finally broken. Various devices have been used for taking care of this arc and rendering it harmless.

Practically all circuit-breakers may be divided into two classes, the air break where the circuit is opened in air, and the oil break where the circuit is opened under oil, the former class being used principally for direct-current service, and the latter class being used principally for alternating-current service.

One of the earliest designs of air-break circuit-breaker was that with auxiliary carbon contacts, and while the types of breakers have been modified from time to time to keep step with progress, the carbon-break feature has been adhered to and has become the practically universal standard for heavy direct-current service. Such breakers have been built in capacities up to 14,000 amperes or even higher and for voltages up to the highest used for direct-current service.

Another early type of air-break circuit-breaker was provided with auxiliary contacts that opened in a strong magnetic field, this offering protection to the main contacts. While this type is still used to a certain small extent, it has been practically superseded by the carbon breaker for all large capacities.

For heavy-capacity low-voltage alternating-current circuits the carbon-break circuit-breaker is also used to advantage, but for higher voltages on alternating-current circuits the oil-break circuit-breaker is now used almost universally. The essential feature of the oil breaker is the opening of the circuit under oil and the smothering of the arc in a restricted space. As a result it has been found that explosions occasionally occur when circuits of large power are opened under oil, and these explosions sometimes rupture the oil tanks or even destroy the breaker. The amount of power that could safely be handled by an oil circuit-breaker depends on the strength of its tanks, the amount of oil and similar features of design, and in general it is not safe to use a small breaker on a system of large capacity if, under certain easily possible conditions, the breaker might be called on to open a short-circuit with the entire power of the station concentrated on it. As the result of long tests and experience, it has become customary, particularly in America, to assign an ultimate breaking capacity to various types of oil breakers. This is usually given as the maximum kilovolt-amperes capacity in normal rating of generators connected to the bus on which it is safe to use a certain breaker.

In determining the ultimate breaking capacity to be assigned to a breaker, due consideration is given to the fol-

lowing points that materially affect the amount of power that can be safely handled. With a non-automatic circuit-breaker such as usually employed in America on generator circuits, the chances are very remote that such a piece of apparatus will ever have to open very much more than the overload capacity of the generator, or at the worst the amount of current that it can develop under short-circuit conditions. With an automatic breaker, however, which will trip out due to an overload or short-circuit on a feeder, it is possible in some cases to have the entire energy of the station concentrated on that short-circuit, and opened by the breaker, particularly if provided with an instantaneous release. The momentary power that may be concentrated at the point of trouble may far exceed that which the machines could continuously develop even under short-circuit conditions, so an instantaneous automatic breaker has severe conditions to meet. If a time-limit relay is used, the conditions are somewhat improved. While it is practically impossible to calculate accurately the exact amount of power which a breaker might be called upon to open in a given station, it is known from tests and long experience in design that circuit-breakers have a reasonable factor of safety when connected to busbars fed from generators with a certain combined kilovolt-ampere capacity, and this has been termed the ultimate breaking capacity for which a breaker can be guaranteed.

Circuit-breakers, either of the air-break type or the oil-break type, may be direct-controlled or distant-controlled, depending on whether the handle is located directly at the breaker or whether some means is provided for closing the breaker from a distance. The smaller-capacity breakers are usually made direct-operated, but with the larger-capacity breakers, particularly for high voltage, distant control is frequently found advisable.

This distant control may consist of a mechanical device, such as bell cranks and rods, sprocket and chain, etc., for operating a breaker by hand from a distance, or it may consist of a scheme of pneumatic or electrical operation.

Some of the earliest large-capacity breakers, such as those furnished to the Niagara Falls Power Company in 1893 for the control of the 5,000-horsepower generators, were made pneumatically operated, and similarly the first large oil circuit-breakers were made pneumatically operated. The direct pneumatic operation was soon followed by the electropneumatic system, and this has been used to a certain extent in fairly modern plants.

The main advantage of pneumatic operation is the comparative simplicity of the pipes, valves, operating cylinders and similar parts with the high pressure that can be concentrated on the mechanism when needed. The disadvantages come from the necessity of air compressors, storage tanks, piping, valves and other appurtenances with the troubles arising from moisture, condensation, water in the exhaust and the troubles inherent in a device that is likely to discharge moist air and water near high-tension apparatus. The losses in the piping are also considerable and limit the distance for which the direct pneumatic operation can be employed to advantage.

The electropneumatic scheme minimizes these last troubles and has practically superseded the direct pneumatic control for all new installations where compressed-air operation is required. In the vast majority of American and European power plants, however, where an auxiliary source of power is used for the switchgear, electrical operation is employed. Most of this apparatus now in service is designed for use on a 125-volt direct-current circuit, although 250, 500 or any other available direct-current voltage can be used.

From time to time it has been proposed to operate the various devices from alternating-current circuits, and while induction regulators are frequently operated by small alternating-current motors, and special breakers such as those for the overhead trolley lines of the New York, New Haven & Hartford Railroad have been operated from alternating-current solenoids, direct-current operation is so much cheaper and the additional complications due to its use is so small that alternating-current operation has made very little headway.

As it is out of the question to illustrate and describe all capacities and types of air-break and oil-break circuit-breakers, a few representative types of circuit-breakers for direct-current and alternating-current service have been selected to show the general tendency of American design for this class of apparatus.

CARBON CIRCUIT-BREAKERS.

Fig. 1 shows a 14,000-ampere, 750-volt, single-pole, hand-operated, carbon-break circuit-breaker arranged for overload release and direct hand closing.

This breaker as well as the other carbon-break circuit-breakers mentioned later have been designed for the heaviest and most exacting service. Simplicity and sturdiness in mechanical details have been combined with those elements of electrical design which experience has shown to be the best practise.

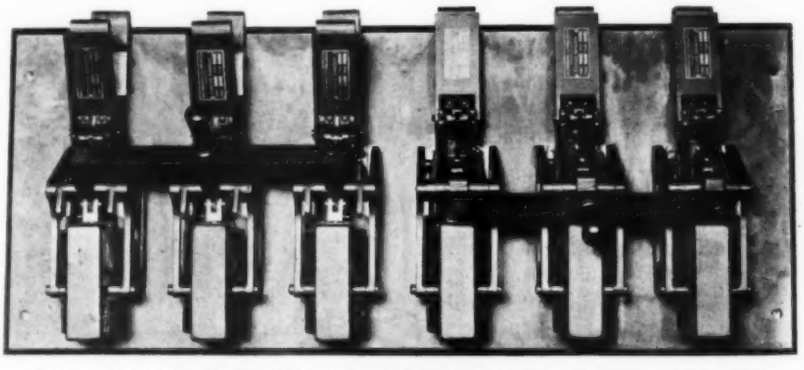


FIG. 2.—800-AMPERE THREE-POLE CIRCUIT-BREAKER, SOLENOID-OPERATED.

The principle of operation of the tripping mechanism on this breaker is the lifting of a weight against gravity by the magnetic pull produced by the electric current. A weight can be moved along a graduated scale-beam by means of a thumb screw and this increases or decreases the amount of magnetic pull necessary to lift the weight. By this means it is possible to set the breaker to trip at any predetermined current, and as long as the current does not exceed that for which the breaker is set, the breaker remains closed.

The circuit-breaker mechanism consists of a swinging arm carrying the main and the arcing contacts actuated by a handle and toggle-joint mechanism. The main contacts are of copper and are laminated to insure per-

feet contacts with the copper blocks which are fastened to the base and connected to the line. Above the copper contacts are the arcing contacts of carbon. These contacts consist of one or more carbons carried by a swinging arm and pressed firmly against stationary contacts when the breaker is closed. These carbons are mounted on a pivot to insure proper adjustment.

When the breaker opens the current is gradually shifted through the copper shunts to the carbon contacts and thus no arc is formed until the final break takes place between the carbon contacts at the top. This arrangement combined with the natural tendency of an arc to rise prevents any injury to the breaker by the arc.

This circuit-breaker will carry its rated direct-current amperes with a maximum temperature rise of thirty degrees centigrade. Owing to the skin effect and eddy-current heating present in an alternating-current circuit, a higher temperature rise occurs when the breaker is used on alternating current.

For smaller currents a somewhat different type of breaker is used. Fig. 2 shows two 800-ampere three-pole solenoid-operated carbon-break circuit-breakers supplied for use with 200-kilowatt 250-volt exciters. These breakers are arranged to connect the exciter to either or both of the two sets of direct-current busbars and their general construction is evident from the cut. These breakers are solenoid-operated and each breaker is provided with a double-contact push button, depressed by the brush of one pole when the breaker is closed, and released when the breaker opens, and this double-contact push button operates the signal lamps on the control desk to show whether the breaker is open or closed.

As an example of larger-capacity solenoid-operated carbon-break circuit-breakers, Figs. 3 and 4 show two 8,000-ampere single-pole carbon-break circuit-breakers controlled as a single two-pole breaker, these cuts showing front and rear view. As may be noted, each pole of the breaker is provided with a separate solenoid and closing mechanism as well as a separate handle for mechanical closing.

For a breaker of this kind it is usual to supply a solenoid-operated switch for carrying the main closing and tripping current for the oil-breakers, this acting practically as a relay and obviating the necessity of having the control device on the switchboard carry the amount of current needed for operating the solenoid of this breaker. A shunt trip device is shown at one side of the breaker.

In Fig. 4, showing the rear view of this breaker, the signal switches used with the indicating lamps can be seen between the studs of the circuit-breakers. This view also shows the steel strap used for mechanically connecting together the frame of the circuit-breaker and the solenoid to take the strain of operation.

OIL CIRCUIT-BREAKERS—INDOOR TYPE.

Owing to the great range and the amount of current, voltage and power to be handled by oil circuit-breakers, various types have been designed to suit different conditions.

Fig. 5 shows a hand-operated three-pole oil circuit-breaker made in capacities up to 300 amperes for voltages up to 2,500. This breaker, shown in the open position with tank removed, is designed to fulfill the demand for a simple, reliable and at the same time inexpensive oil circuit-breaker. Among the advantageous features of this circuit-breaker are the following: compactness of form; ample contacts of the butt type; complete inclosure in the oil tank of all contact parts; facility to open the circuits under conditions of heavy overload without injury to the contacts by excessive arcing; open position maintained by gravity; accessibility of operating parts for the purpose of inspection and repair; and full automatic op-

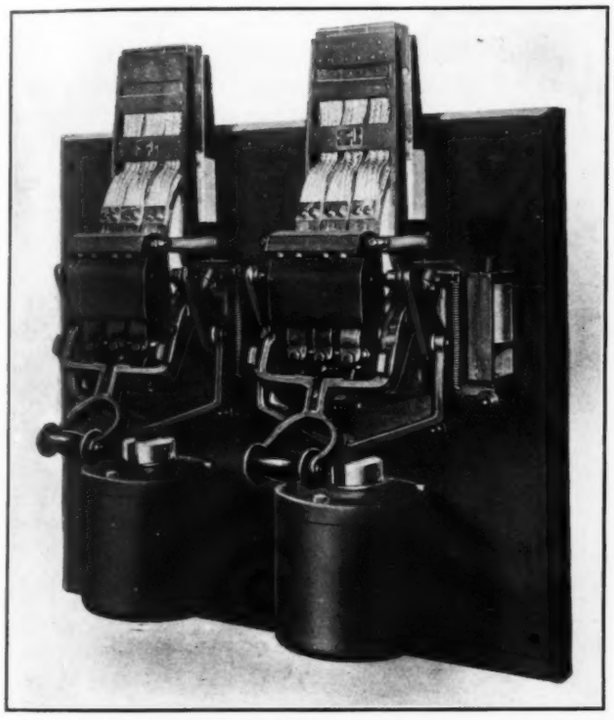


FIG. 3.—8000-AMPERE TWO-POLE CIRCUIT-BREAKER, SOLENOID-OPERATED.

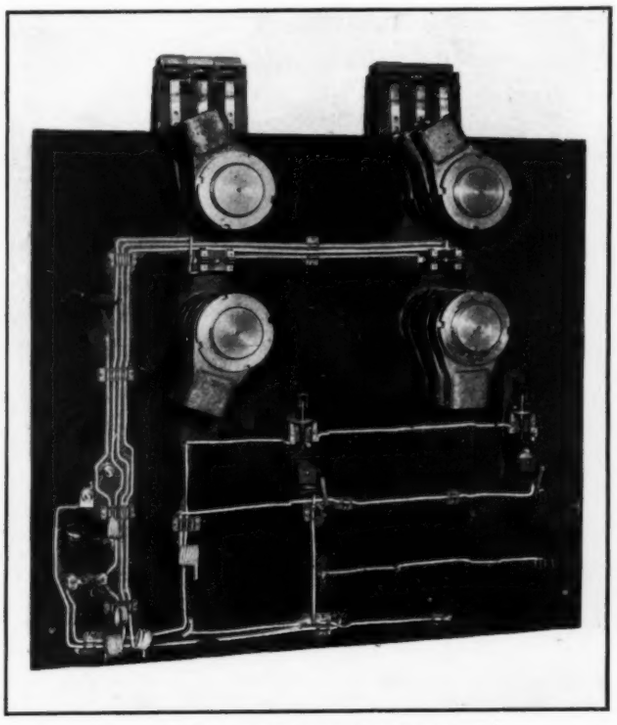


FIG. 4.—REAR VIEW OF SAME.

eration. This type is equipped with overload-release trip coils suspended from the frame of the breaker, immersed in oil, and connected directly in series with the line. The plungers of these trip coils are retarded in their action by a device giving the circuit-breaker an inverse time element. This breaker is also equipped with a device that renders it impossible to close the breaker or hold it in the closed position while a continued abnormal overload condition or short-circuit exists on the line.

All of the operating parts of this breaker are suspended from an iron frame to which the oil tank is securely attached, this tank being made of heavy iron with all seams welded and provided with an insulating lining and barriers between the poles practically isolating each pole within its own compartment.

The contacts consist of cylindrical brass rods, the lower ones being backed up by individual spiral springs to insure contact and form the well known butt-contact type. This type of contact, familiar in the multiple-unit system on heavy street-railway equipments, has been adopted with great success in oil circuit-breaker practise. It insures good contact always and prevents any possible failure due to eating away the contacts by continued arcing. The compression springs mentioned take up any wear that may occur and render the contacts self-alining. These contacts are very readily removed and replaced.

Fig. 6 shows a 300-ampere, 6,600-volt breaker of the next largest type, which is built in capacities up to 2,000 amperes at 600 volts, 200 amperes at 22,000 volts. In this type of breaker each pair of contacts forming each pole is in a separate tank with insulating lining. This breaker is readily arranged for hand operation as shown in Fig. 6 or electrical operation as shown in Fig. 7.

Through a very simple system of levers the operating handle is connected to a cast-iron cross-arm to which are fastened the movable wooden contact arms. To the lower end of the wooden arm is fastened a metal yoke with a butt contact on either end. When the circuit is closed these contacts engage with two stationary contacts forming one pole of the breaker. Each stationary contact is supported by porcelain insulators rigidly secured to the frame. The leads are brought to the terminals of the stationary contacts within the insulator, forming an unbroken and continuous insulated conductor between the circuit-breaker and the busbar or line. As mentioned previously, each pole of the circuit-breaker has a tank with live metal parts immersed in oil, each tank being entirely independent of the adjacent one. These tanks have a lining so formed as to reduce the quantity of oil required and to form a barrier between the two stationary contacts, yet allowing ample space for the movement of the wooden arm in its contact. Any one of the tanks can be easily removed without interfering in any way with the others.

This breaker like the one previously described cannot be held in the closed position, if an excessive overload exists on the line. The tripping coils contained in the cover plate on the front of the breaker are operated from the secondary circuits of current transformers.

Figs. 7 and 8 show the 2,000-ampere 600-volt solenoid-operated breaker of this same design. In this capacity the main contacts of the circuit-breaker are of the laminated-brush design with auxiliary contacts of the butt design. It may also be noted that the stationary contacts are massive copper blocks provided with laminated strap connection, passing up through the supporting frame of the breaker. In this breaker, intended for low-voltage service, all of the contacts are placed in one tank.

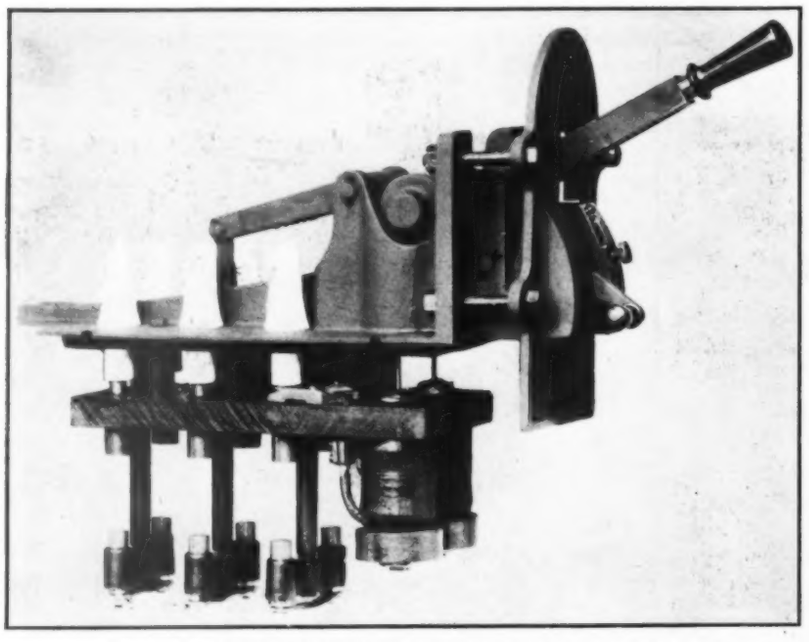


FIG. 5—300-AMPERE HAND-OPERATED OIL CIRCUIT-BREAKER.

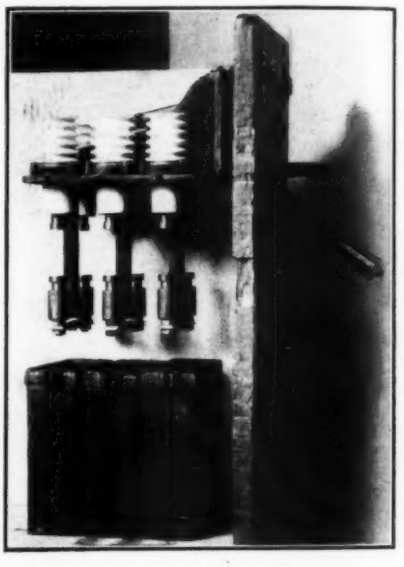


FIG. 6.—OIL CIRCUIT-BREAKER.

The oil circuit-breakers previously illustrated and described are self contained and can be mounted on a wall, framework, switchboard panel or suitable supports or may be placed in a masonry structure if desired. The independent cellular construction of placing each pole of the breaker in a separate masonry compartment is not ordinarily required in plants having a capacity that would permit the use of these breakers.

(To be continued.)

The use of electric current in China is rapidly increasing. Power stations have recently been started in Hankow and in Wuchow.

The Electrification of Norwegian Railways.

A committee appointed for the purpose of looking into, and reporting upon, the question of electrification of Norwegian railways has now handed in its report. The committee has examined the matter of electric traction in various countries, and strongly recommends a thorough investigation of everything connected with the electrification of Norway's railways, which seems to be favored by several circumstances. While some of the large countries had invested immense capitals in the construction of railways, and had their railway system complete for steam traction before the question of electrification arose, Norway's railway system, in spite of spirited railway building for several years, is not by a long way complete. The electric system can, therefore, be tried on new lines, where due regard can be paid to electric traction during the planning and the building of the line, without outlay on an expensive stock of steam locomotives, etc. Besides, the less satisfactory financial results of the Norwegian railways make it particularly desirable to adopt a cheaper system, if such can be found, and, finally, Norway has in her many waterfalls a medium for generating cheap electric energy. The question of electric traction is by no means one of recent date in Norway, having been discussed for some twenty years, yet the Norwegian railway authorities have not gone anything like so thoroughly into the matter as have several other countries. Since 1892, when the purchase of waterfalls by the state for the electrification of railways was first brought forward, the State has acquired several large and small waterfalls in different parts of the country; but whether these are so situated and have such natural conditions that they are well suited for the generation of electric energy for railway traction, yet remains to be seen, and has not, so far, been fully examined into. The State railways have prepared some provisional plans and calculations for the electrification of a number of old and new railways, and the building of an electric branch line (the Myrdal-Fretheim line) to the Bergen Railway was decided upon in the year 1908. Last year the Railway Board prepared plans and calculations for the electrification of the Christiania-Drammen Railway, but beyond this the authorities do not appear to have taken any steps for the electrification of the country's railways. Of private railways with electric traction there are at present in Norway the following lines: Hafslund-Sunnesund (transport), Christiania-Holmenkollen, Thamshavn-Lökken, Notodden-Tinoset, and Rollag-Staalheim, the last two of which are not yet quite ready. The committee holds that Norway, instead of being left behind, ought to take the lead in the matter of electric railways, and recommends a general and thorough investigation of the question of the importance of electric traction for the Norwegian railways. This investigation ought to comprise the amount of power required and the selection of suitable waterfalls; the financial aspect of electric traction for the Norwegian railways; the possibility of fixing a uniform electric equipment and system for the country's electric railways, and the possibility of joint traffic with the Swedish railways, as well as the importance of electric traction for the building of new railways as regards track and construction. It is recommended that this investigation should be left to a committee comprising experts in the domain of electricity, electric railway traction, hydraulics, and railway construction.—*Engineering.*

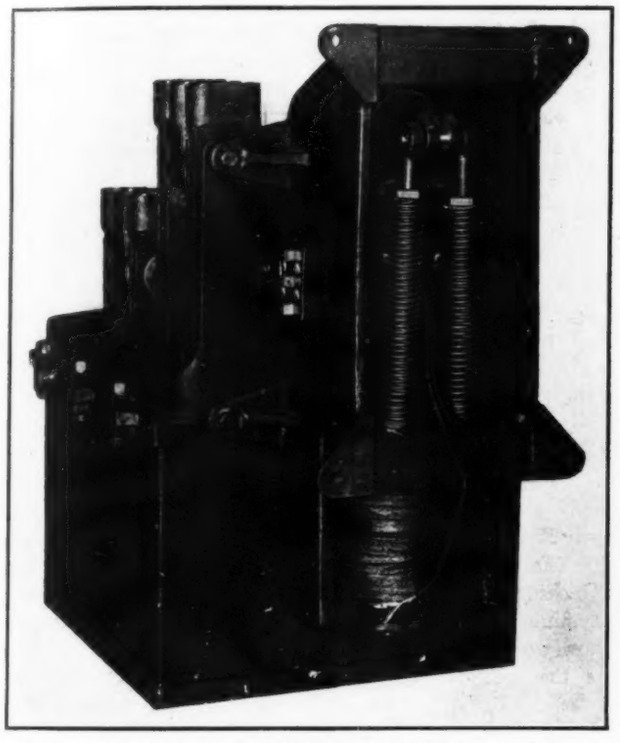


FIG. 7.—2000-AMPERE SOLENOID-OPERATED OIL CIRCUIT-BREAKER.

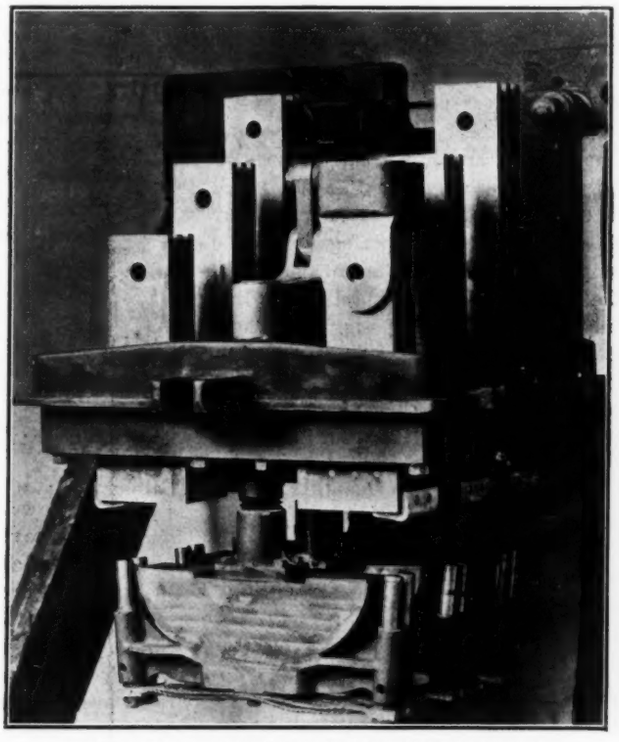


FIG. 8.—REAR VIEW OF SAME CIRCUIT-BREAKER.

A NEW METHOD OF DETERMINING THE EFFICIENCY OF SLIP-RING INDUCTION MOTORS.[1]

BY H. J. S. HEATHER.

The machine usually called the induction motor may be looked upon as the most general form of the transformer. It has the power of transforming both frequency and voltage in any desired (though not independent) ratio; it is also able to change electrical into mechanical energy and *vice versa*. If the primary (or stator) of such a motor is connected to a source of alternating-current supply, and the rotor clamped so that it cannot turn, the secondary (or rotor) may be made to give out, from its slip rings, currents of the same periodicity as the supply. The mechanical control of its movement results in its acting wholly as a transformer, and its mechanical output is zero. If, on the other hand, its electrical output is reduced to zero by short-circuiting the slip rings, its whole output takes the mechanical form and the rotor rotates at a speed depending only on the torque opposing its motion. Between these two extremes any number of intermediate conditions may obtain in which the output is partly electrical and partly mechanical, the proportion between the two parts being dependent upon the torque the machine is compelled to give out mechanically and the resistance between the slip-rings from which the electrical output is derived. If there were no losses in the machine, the total output at a fixed current input would be absolutely constant, whether this output was wholly electrical, wholly mechanical, or partly electrical and partly mechanical.

There must, however, be losses, and these losses come under the following headings: primary iron loss, primary copper loss, secondary iron loss, secondary copper loss, friction loss. The secondary output, plus these losses, must be equal to the primary input.

Now, suppose that the primary is taking in a certain fixed current from a constant-potential supply. Then, of the above losses, the primary iron loss, primary copper loss and secondary copper loss remain unaltered whether the machine operates wholly as transformer, wholly as motor, or partly as one and partly as the other. The only losses that change, therefore, through altering the function of the machine from transformer to motor are the secondary iron loss and the friction loss.

If, therefore, we can ascertain what changes these two losses undergo in changing the machine from a transformer to a motor, the machine's mechanical output as a motor can be determined by measuring its electrical output as a transformer and applying the correction demanded by the changes in the above mentioned losses, viz., those in friction and in the secondary iron. The fact of the existence of slip will be taken into account by this procedure, as the slip corresponds to the current used and the rotor copper losses will not be included in the electrical measurement of the output.

This correction can be found quite simply. The machine can be run as a motor without load and with its rings short-circuited, and the watts and current input can be measured. The secondary current will be small enough to be negligible (though it can be measured if it is thought necessary), and so will the secondary iron loss, for the secondary periodicity is practically zero. The power input minus the primary copper loss is consequently equal to the primary iron loss plus the friction loss.

Next, the rotor can be clamped with its rings open-circuited and the primary switched on to the mains. The clamping is necessary because eddy currents in the iron may be sufficiently large to start the machine as a motor. The watts and current input are then measured as before. The watts input minus the primary copper loss are now equal to the primary iron loss plus the secondary iron loss at standstill.

The two tests above described are carried out under the same conditions of applied voltage, periodicity and magnetic circuit, and the two currents are almost identical, so the induced as well as the applied voltages are practically the same. Consequently the fluxes and the primary iron losses must be the same. The difference, therefore, between the watts input minus the primary copper loss in the first test and the watts input minus the primary copper loss in the second test will give us the difference between the friction loss at full speed and the secondary iron loss at standstill.

Now, whenever the machine is acting purely as a motor, its slip will be so small that we can regard the friction loss as constant and the secondary iron loss as negligible at all loads. The error introduced by each of these inaccuracies is, of course, only a very small percentage of the total losses, and, moreover, the errors are not cumulative but in opposite directions. The difference found above between the friction loss at full speed and the secondary iron loss at standstill can, therefore, be applied at all loads as a correction to the value of the electrical output as a transformer in order to arrive at the mechanical output as a motor.

In order to get at the electrical output as transformer, it is only necessary to clamp the rotor, insert a high resistance between the slip-rings, and after switching on the stator, to reduce this resistance until the current going into the stator is that at which the efficiency is required to be determined. Wattmeter readings of the primary input and the secondary output are then taken. The output is then corrected as indicated above to determine the mechanical output as motor, and the ratio between this and the input is the efficiency.

The method above suggested has the advantages of requiring electrical measurements only, and the use of only one motor and no belts. Both in simplicity and accuracy it appears to compare favorably with any previously described process.

1 From *The Electrician*.

The Telephone Pioneers of America.

The first meeting of the Telephone Pioneers of America has been called to be held at Boston, Mass., Thursday, Friday and Saturday, November 2, 3 and 4.

President Theodore N. Vail and Alexander Graham Bell have signified their intention to be present, and it is believed there will be a large attendance from all parts of the country.

It was practically the unanimous vote of the Pioneers to meet in Boston in view of its being the birthplace of the telephone.

Arrangements as to entertainment and meeting will be announced later. Those contemplating attendance are requested to send word as promptly as possible to one of the committee, consisting of Henry W. Pope, Charles R. Truex and Thomas B. Doolittle, 15 Dey Street, New York, N. Y.

An electric railway in Russia connecting Sebastopol with Jalta and Aluschta is in contemplation. The cost is estimated at $14,500,000.

Central-Station Practice

LABOR COSTS AND LOAD-FACTOR IN CENTRAL-STATION PRACTICE.

BY C. L. HERRICK.

In the great majority of steam-driven central stations, the cost of fuel is the largest element of manufacturing costs. It is natural, therefore, that efforts to improve the economy of production should be directed against losses primarily due to the operation of the main and auxiliary equipment and in the saving in various transformations between the coal pile and the station busbars. The average efficiency is none the best, as is shown from an analysis of the average losses in the conversion of one pound of coal into electricity. Therefore, other elements of the manufacturing cost, such as labor, supplies, repairs and renewals, often assume secondary places in the minds of engineers responsible for the operation of plants in commercial service. Experienced managers realize, however, that while it is an excellent plan to pay the most attention to the items of station expense which lead the rest in magnitude, the combined savings sometimes possible in items of less individual importance amount in the long run to more than it would seem possible without due consideration. By paying special attention to the smaller features of labor cost, the aggregate saving to the station in both total cost and, as derived therefrom, the cost per kilowatt-hour, it is possible to secure increased economy which in a year's time will make a considerable showing. The most important of the items of manufacturing cost in a modern central station, after the fuel expense, is usually the labor cost per kilowatt-hour. This may vary through quite a range of values on account of the personal equation and the difference in plant design.

This cost for labor will vary with the character of the load throughout the day; if the load is so variable that it requires considerable placing in service and taking out of service of auxiliary units, it will require an increased operating force over and above that necessary for the station with a fairly uniform load which does not require the aforementioned attention. The labor cost is also influenced greatly by the design of auxiliary units with respect to the necessary adjustments and oiling in operation and again by the arrangement as would be shown on a floor plan. The possibilities of supervision from a central point in the engine room, the compactness of the station, and its symmetry of organization, provisions for emergency service, also the prevailing scale of wages, all enter into this element of labor cost.

The presence or absence of automatic equipment in the boiler, engine, and auxiliary divisions, all have an important bearing on the advisable personnel of the operating staff in so far as a certain degree of intelligence is required which varies with the design of the equipment. This cost of expert labor should be balanced against the cost of a less intelligent personnel, operating simpler but more inefficient auxiliaries, in choosing which is the most economical from a commercial standpoint. In spite of these various conditions, however, there are two points of permanent significance in the work of obtaining a low labor cost per kilowatt-hour for a plant of given equipment or for a station of constantly expanding output.

The secret of economy in labor in a plant whose equipment is temporarily established at a definite capacity is to run the station at the highest possible output consistent with the giving of reliable service. In other words, the two points to take into consideration are the size of the units and the highest possible average output of each consistent with reliable service. It is the ratio of the possible capacity of the unit or units in operation to the total coal output, which is the governing factor in the cost of labor per kilowatt-hour. Experience shows that when a plant is underloaded, the output for each attendant in the boiler and engine room may frequently be increased by a large percentage without any additional expense in wages, but it may cost slightly more for repairs and renewals. This point lies very near to the basis of the economy which can be increased by the securing of a good power load in the daytime of about the same capacity as the lighting load will be at night.

When you get such a load you can run your plant well loaded and there will be no increased labor cost, and since the labor cost per kilowatt-hour is equal to the total labor cost per day divided by the actual ouput in kilowatt-hours per day, you can see that the cost per kilowatt-hour will be reduced in direct proportion as the output in kilowatt-hours per day is increased up to the point where it is not necessary to add another unit to carry the load. This is one definition of load-factor, that is the ratio of the average output to the possible output when the unit was running fully loaded for the same number of hours in each case.

The following point, however, is to be remembered: if the load falls due to a business depression, which falling off will last for periods longer than twenty-four hours, it is possible by shutting down a part of your plant to reduce nearly all the items which come under the head of manufacturing costs. This saving, however, cannot be made complete, as shown by some items of the fixed charges, for the reason that these are based on the investment or cost of the plant, which, when it is once built, cannot be decreased; fixed charges, therefore, cannot be reduced by shutting down apparatus except possibly in the matter of depreciation, but it is problematical how far it pays to let a machine stand still to avoid the deterioration which causes us to make a depreciation allowance, since an idle unit requires frequent care to prevent a certain loss of condition which would prevent you starting it up without a complete overhauling, and thereby entails a labor expense if this loss of condition is to be avoided.

The manufacturing cost of producing energy at times when the load is light is dependent in a way on the load, while the fixed charges are constant and must be realized and pro-rated

over the output of the station whether the same is run to its full capacity or at a lower load-factor. Another point of economy in the station, where load conditions are changing in such a way that larger units may be substituted for quite a number of small units, lies in the fact that it does not require any more men to operate a large unit than to operate a small unit. Consequently, if four small units can be replaced by one large unit, the labor cost per kilowatt-hour will be reduced to one-fourth that which it would be for four small units. The actual limit of machine capacity that can be handled by one man in a turbine station, for instance, does not seem to be reached as yet in a well designed station, but again it does not pay to install one large unit under certain conditions, for the reason that when the load does fall off you cannot cut out of service any part of that unit. Consequently, it does not give a chance for economy in that direction, so the proper solution will depend on the character of the load, and it will be advisable to install such generating units of a capacity that would make it possible to secure reasonable loading on machines in service and also to avoid unreliability which you get in one large unit for the reason that if anything happens to the one large unit, your entire plant is out of commission.

Yet, as I stated before, it requires a larger force per kilowatt of machine capacity to handle a station equipped with a number of small machines than to operate an installation composed of a few large units. This is shown by both tables I and II. As the previous remarks introduce the fact that by keeping good load-factor on the station it is possible to get a greater kilowatt output up to a certain point without increasing the manufacturing cost except in the matter of coal, and since the fixed charges do not increase or decrease, it is evident that for a high average load, or what amounts to the same thing, a high load-factor, the cost per kilowatt-hour will decrease about in the same proportion that the kilowatt-hour output increases, up to the point where it is necessary to put an additional unit in service.

Now speaking about the point of putting an additional unit in service, figured on the cost of producing power from one unit, it should be noted that it may be necessary to make the plant up of several of these units, or it may be made up of a combination of different sized units, which would be advisable in order to keep the units reasonably well loaded. We have now discussed economy as relating to the manufacturing costs and to the fixed costs or charges on the necessary plant equipment to carry the load, but in order to secure a certain degree of reliability of service, it may be found advisable to have an additional unit or units to use in case of emergency or accident, but which would not be required in case the accident or emergency never happened.

TABLE I.
Labor Costs in Selected Central Stations.

Plant.	Approx. K. W. Rating.	Total Station Wages.	K. W. H. Manuf'd.	Labor Cost Per K. W. H. Cents.	Total Mfg. Cost per K. W. H. Cents.	Total No. Station Employees.
A	6,000	$25,937	8,776,165	0.296	1.21	22
B	5,000	20,920	6,043,204	0.346	1.23	20
C	4,000	19,429	5,400,192	0.36	1.24	28
D	2,000	9,954	3,288,623	0.302	1.42	11
E	2,000	9,663	4,305,003	0.224	1.27	13
F	1,250	6,844	1,470,066	0.465	1.56	8
G	950	8,771	1,479,898	0.595	2.05	7
H	700	6,669	889,760	0.750	2.34	8
I	630	5,017	730,458	0.685	1.80	6

TABLE II.
Plant Capacity and Labor Cost.

Plant.	*Approx. K. W. per Station Employee.	Station Wages per K. W. Station Capacity.
A	272	$4.31
BB	250	4.18
C	136	5.10
DD	182	4.97
E	154	4.83
F	157	5.45
G	136	9.25
H	*87.5	9.52
I	105	7.95

*About two times the above listed kilowatt capacity per station employee is handled on each actual watch, assuring two shifts per day.

This introduces a third item of expense, for the reason that there will be no manufacturing costs in connection with this unit, for when it is run, it will be run in place of some other unit which has been shut down. However, there will be the fixed charges on this unit and as this unit does not have any earning capacity itself, running only to replace one of the other units, the fixed charges on this unit must be pro-rated over the output of the regularly operated units; consequently, we will add a third item to our manufacturing costs which is a fixed charge depending on the extra unit or units to insure reliability or service. We now have the matter of costs of power as made up of three parts:

(A) A manufacturing cost, which is proportional to the amount of power used. Such a proportional cost, for instance, is that of fuel in the steam plant.

(B) A fixed charge, that is, a cost which is independent of the amount of power used, but which is based on the investment made to build the plant and is consequently the same whether the plant is fully loaded or carries practically no load, or at any intermediate condition of load between these limits, which condition of load is called load-factor. This includes depreciation, interest on bonds, annuity to redeem bonds, taxes and general expense, which consists of salaries of officers, clerical force, etc.

(C) A fixed charge that depends on the reserve station capacity which is necessary to insure the reliability that is required by the service to which you are catering. This last charge may include such other items as a storage-battery reserve in certain instances.

Since of the three parts of the cost only one (A) is proportional to the power used, hence approximately constant per kilowatt output, the other two parts (B and C) being independent of the output, hence higher per kilowatt the smaller a part of the capacity of the plant is used, it follows that the cost of power delivered is a function of the ratio of the actual output of the plant to the available capacity of the plant, and this, as stated before, is one conception of load-factor and is the one we have used all through when predetermining the plant characteristics. As a result of such predetermination, we have the cost of power at 50, 75, 100 and 125 per cent load-factor.

The cost of electric power in different steam plants is therefore not directly comparable without taking into consideration the reliability of service and the character of the load. As a very large part of the cost of power, that is the fixed charges, is independent of the power utilized and therefore rapidly increased with decreasing load on the system, the ratio of average output to the available power capacity of the plant is of fundamental importance in the economics of the cost of power per kilowatt-hour. One point that should be emphasized now in connection with the understanding of load-factor is this:

The definition in the standardization rules of the American Institute of Electrical Engineers is the ratio of the average load to the maximum load, instead of, as we have before conceived, the ratio of the average load to the load when the unit is fully loaded. This distinction is made for the following reasons.

When we were first deliberating on this matter, we had under consideration one unit only. When we make up the station we may introduce a spare unit and consequently, if you take into consideration the capacity of the spare unit in figuring the load-factor when it is evident that you will not run this unit, the load-factor is bound to be very low. But from an operating standpoint this unit would not be cut into service and only such a number of units be placed in service as will be able to carry the maximum load. Consequently when you consider the load-factor as the ratio of the average load to the maximum load in excess of station capacity, which would be capacity beyond the maximum load, this is considered as power which has not yet been sold but which is still available for the market or which is held in reserve for emergencies and is not charged against the load-factor.

The cost of electric power depends essentially on the load-factor. The higher the load-factor the less is the cost of power, and a low load-factor means an abnormally high cost per kilowatt-hour. It would be well at this point to explain what can be considered as the maximum load, that is the length of time which the maximum load can last or continue. We know that our apparatus will stand overload for short periods, but sometimes these overloads reduce the voltage on the system. Now, in case of a motor load, if this reduction in voltage is to last for say one-half hour, it would not affect the performance of the motors for the reason that it would result in a rising temperature, but the motors are good for the apparent over-load condition due to reducing the voltage for certain guaranteed periods of time. But this is not the same in a lighting business for reasons that are apparent and you cannot hold the lighting customers unless you have good voltage regulation. Therefore, the duration of maximum load which is chosen in determining the load-factor is that which is permissible without being objectionable for the purpose for which the electrical energy is distributed.

Thus, in a lighting system, where voltage regulation is of foremost importance, minutes will probably fix the limits of permissible maximum load and maximum load may be defined as the average load during that minute at which the load is a maximum; while in a power system a half hour or an hour may be used as a duration of maximum load, for the motor performance is not much affected by a drop of voltage due to overload, and an overload of an hour or so may be carried by the overload capacity of the generators and this can be met by the heat storage of some boilers. But the peak load may require the cutting in of additional capacity on the power load if this should exceed one or possibly two hours, so that there is quite a field for the use of good judgment and the understanding of use of power for industrial purposes in order to keep a high load-factor on the plant and consequently to be able to make a low rate per kilowatt-hour.

It is not the intention that this should be considered as an exhaustive treatment of the subject as a whole, or of the details. This article is intended to point the way to efficient transformers of energy and to the possibilities of increasing these efficiencies, and by so doing to save the dollar, or which amounts to the same thing, to make the dollar earn the most money.

It may appear to some that this matter of efficiency or economics as presented here is a form of worship of the almighty dollar, but I think a little general reasoning will show that this is not the case in so far as the engineer himself is concerned. A very small percentage of the engineers responsible for energy transformations have any of their own money invested in the projects of which they are in responsible charge. The engineer's services were secured for the reason that he had made it his life's business to use the materials at hand in such a manner that the use thereof will be of vital consequence to mankind in that he can use the materials, or the potential energy at hand, with the most saving, which means, getting the greatest results with the least expenditure of money. And while it is true that the engineer who can get the greatest output for a given investment will be considered worthy of the highest salary, the raise in salary or the increase of his income comes as the result of proper understanding of his business and not from a mere worship of the almighty dollar.

Electric Traction in Spain.

The first attempt at applying electric traction to a Spanish steam line was made recently by the Southern Railways Company.

The Giraud System of Line Protection.

This system of protection, which was recently described in *La Lumiere Electrique*, short circuits the power-transmission line as soon as there is a break. The circuit-breaker at the power station is then immediately opened and power is cut off before the live line can do any damage to life or property.

On an aerial line such as is shown in Fig. 1, the lower line equipped with the device goes to the power station. On the insulator there is a collar which fastens the lever AC at the point A. The cable B is fixed to this lever by means of automatic jaws so that it is held tightly without marring the cable so as to weaken it. The conductor in case of a break pulls on the lever at the point B throwing the force at the terminal against the other line and short-circuiting the system.

Because of the considerable tension which is exerted by the line the movement of the lever is extremely rapid and

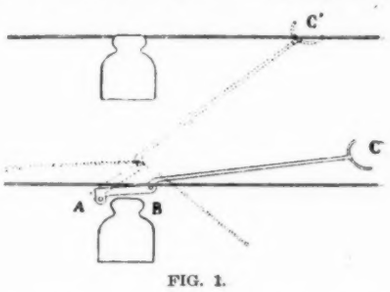


FIG. 1.

the short-circuit is practically instantaneous. Experiments made with different lines have demonstrated that the current is broken even before the actual fall of conductor so that when the conductor lies on the ground within reach of any possible meddler it is dead.

The upper conductor of the line is protected by similar device set to work in a downward instead of an upward direction. Horizontally or obliquely acting levers are also made. On three-phase lines one of the phases is short circuited by the breaking of a wire.

In order to prevent a too great swinging of the lever with the swaying of the wire which the wind causes, the part AB rests in a groove cut in the top of the insulator.

Only one post in three needs to be furnished with the Giraud apparatus, but it is quite evident that in this case the conductor must not be fastened firmly to the intermediate insulators. To allow movement, the line is held in a groove which does not prevent the movement necessary for the operation of the lever.

Electric Lighting and Illuminating Engineering

Corrections for Photometric Flame Standards.

A paper by W. J. A. Butterfield, J. S. Haldane, and A. P. Trotter, read at the meeting of the International Photometric Commission at Zurich, Switzerland, in July, contained a record of a research on the corrections for the effects of atmospheric conditions on photometric flame standards The effects of the pressure, degree of humidity and vitiation of the atmosphere on the Harcourt pentane and Hefner amyl-acetate lamps were investigated by the aid of a steel chamber, sufficiently commodious to accommodate two observers (placed at the disposal of the authors by the Lister Institute of Preventive Medicine), in which any variation of conditions could be made and recorded. The lamps were placed below a hood directly connected with the outlet airway. A small metal-filament lamp fed by accumulators and considerably underrun to obtain a suitable color, was used at first as a standard, but subsequently a Fleming-Ediswan carbon standard was used. The methods employed and the results are detailed in the paper.

The principal results may be summarized as follows: The curve connecting air pressure and correction factor is for the Harcourt lamp nearly a straight line for the range of 700 to 850 millimeters, and shows that within these limits the light increases or decreases by one per cent, with an increase or decrease respectively in pressure of 12.5 millimeters, or that a variation of 10 millimeters in pressure is attended by a variation in the same sense of 0.8 per cent. in the light afforded by the lamp. The curve of the Hefner lamp is likewise nearly a straight line for the range of 700 to 850 millimeters, and shows that within these limits the light increases or decreases by one per cent with an increase or decrease respectively in presure of 25 millimeters, or that a variation of 10 millimeters in pressure is attended by a variation in the same sense of 0.4 per cent in the light afforded by the lamp. Sets of observations on the Harcourt lamp showed that a change in the temperature *per se* of the air from eight degrees Centigrade to over twenty degrees Centigrade had no definite effect on the light afforded, but the light of both the Harcourt and Hefner lamps decreases by one per cent for an increase of 0.16 per cent in the aqueous vapor in the air, so that an increase of one per cent in the aqueous vapor in the air is attended by a decrease of 6.25 per cent in the light of the lamps. It was also found that one per cent decrease in the light of the Harcourt lamp was caused when approximately 0.035 per cent of carbon dioxide was present in the air, and in the light of the Hefner lamp with 0.045 per cent.

Another Controversy Over Street Lights.

The Common Council of Hudson, N. Y., engaged two engineers to test the street are lamps, which according to the city's contract with the Albany Southern Railway Company are specified as 2,000 candlepower. The report of the tests was that the average amount of light from each lamp was less than 1,000 candlepower. According to newspaper reports the city will contest payment for more light than is actually being furnished. Another protracted controversy over this old question is likely to result.

Deterioration of Quartz Lamps.

Experiments by Courmont and Nogier, reported in the *Revue Industrielle*, show a progressive diminution in the radiation from quartz mercury-vapor lamps working at high temperature.Both the luminous and ultra-violet rays diminish steadily from the start. The change is in the quartz and is permanent. To prevent the deterioration, it is necessary to adopt means for cooling the quartz tubes while in use.

Wireless From an Aeroplane.

Captain Brenot and Lieutenant Menard, both of the French Engineer Corps, succeeded in dispatching wireless messages from a Farman biplane at a height of 1,600 feet to the Eiffel Tower, a distance of thirty-five miles.

An Old Electric Lighthouse Installation.

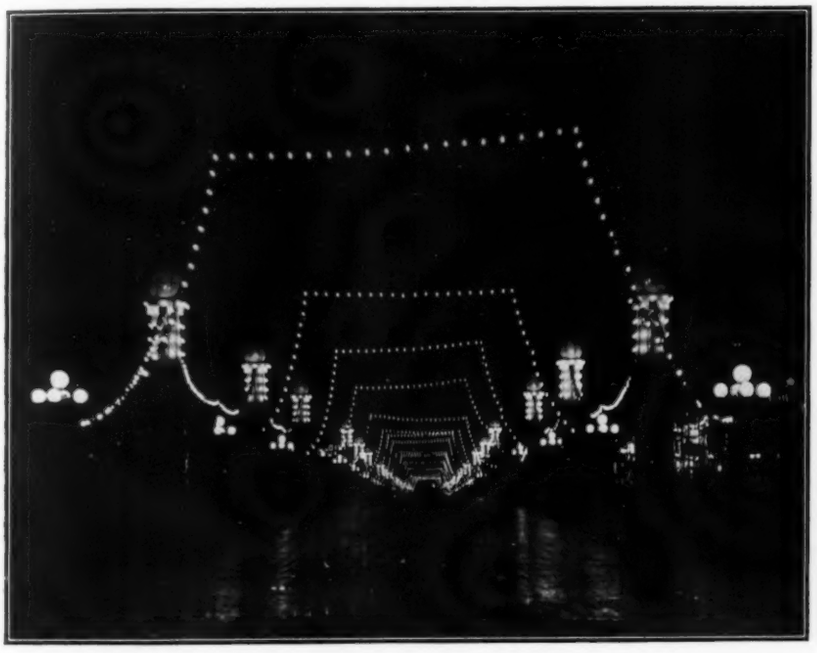
An electric lighting plant that is interesting on account of historical features rather than its efficiency is that of the South Foreland Lighthouse on the cliffs between Dover and St. Margaret's Bay, England; this was recently described in *Electrical Engineering*. At the present time only the "high" lighthouse is in use, as the "low" lighthouse, lower down on the cliff, was put out of service some years ago, when the fixed light of its partner was converted into a revolving light. The light is given by a single vertical-carbon open-arc lamp, with clockwork feed and fluted carbons about seven inches in length, which have to be renewed several times in one night. For this purpose, two separate lamps are employed, arranged so one can be slipped into place when the other is withdrawn for carboning. Alternating current, at a high frequency, is supplied, and the lamp takes about sixty amperes.

The power station is about 100 yards distant, and contains steam-driven alternators of the old Holmes magneto pattern, with rows of inwardly pointing permanent horseshoe magnets between the poles, between which pass the coils of the revolving armature. Two such alternators are used in series on the arc lamp, and they are coupled together and driven by an elaborate arrangement of countershafts, fast and loose pulleys, from a single-cylinder horizontal engine. A duplicate plant was used for the low lighthouse, and is now retained as a standby. The engines have each their own condenser, with the air pump worked off the tail-rod. Steam is supplied at thirty-five pounds per square inch from a pair of Cornish pattern boilers. The alternators have been running for over forty years, and are still in excellent condition. The magnets are, however, remagnetized every few years. Of switchboard, properly speaking, there is none, but the circuits are connected up to links on a wooden board. The plant is an interesting example of practice in the pioneering days of electrical engineering.

Special Illumination During Minneapolis Civic Celebration.

During the week ended July 8 there was held in Minneapolis, Minn., a notable civic celebration in which electricity played an important role.

The illustration pictures fairly the scheme of electric lighting which was carried out for nine blocks along Minneapolis' most famous retail street. Fifty-four of the large white pillars were required for the so-called court of honor. These pillars were twenty-five feet in height, five feet square at the base and capped by illuminated globes of forty inches diameter. They were further embellished with ornamental designs in relief and each pillar was faced with a shield bearing the name of some prominent Minnesota pioneer.



SPECIAL ILLUMINATION IN MINNEAPOLIS.

Supplementing the large pillars above alluded to, seventy-two ornamental standards finished in imitation bronze were capped with clusters of five one-hundred-watt tungsten lamps. Each standard was further beautified by a circular ring-shaped pot of flowering plants. Eighteen thousand running feet of potted plants were used by the merchants alone in beautifying their store fronts by day, while at night the combination of illumination and floral display made Nicollet Avenue in very truth a court of honor.

Over 8,800 sixteen-candlepower lamps were called into service on the festoons and pillars herein described. Practically 1,800 of these lamps were used on the festoons crossing the avenue, 2,700 lamps on the pillars among the plaster decorations and 4,300 lamps on the festoons parallel with the curb. A connected load of 700 horsepower of electrical energy was required in the nine blocks devoted to special electrical display.

Arborvitae was used profusely among the lights in the court of honor giving the whole the effect of a great canopy of light and greenery — undoubtedly the most beautiful and most expensive effort in street lighting ever put forth by any city.

Each day of the celebration was marked by some distinct attraction. On Sunday, July 2 there was held a military parade. Monday was National Guard day, the troops passing in review before the governor. Tuesday, July 4, was a notable exception to former Independence Days in that the customary indiscriminate and senseless firing of explosives by individuals was entirely eliminated, the public joining as a unit in the feature provided by the committees having the celebration in charge. Prominent among these events were the illuminated canoe and row-boat parade on Lake Harriet and a monster fireworks exhibition of unparalleled grandeur.

The Linking of the Lakes, the supreme act, about which all else centered occurred on Wednesday, July 5. At this time the waters of Lake Calhoun and the Lake of the Isles were joined. The evening of this day was made memorable by a pageant of illuminated ships passing in review before "Minneapolis" seated on a throne upon a floating barge.

An artistic feature of this pageant was a realistic picturing of Minnehaha Falls in which electric light played an essential part. Over 100-horsepower of electric energy was used for this one feature while throughout the whole pageant electricity was much depended upon.

While the Civic Celebration was excellent municipal advertising it was a triumph electrically.

Illumination in Tripoli.

Tripoli is a city of about 40,000. Its stores are few and all are closed at sunset. There is practically no business done in the evening, and for that reason there would be no demand for lights in the shops, and apparently there would be but little demand for special lighting devices in the few homes that would ordinarily be expected to have the best lighting system.

Petroleum lamps are used by everybody and quite recently the American lamp has entered this market and promises to outbid all competitors.

Until last May the street lighting had been very unsatisfactory, as ordinary kerosene lamps were used, but recently a German agent doing business in Tripoli persuaded the city authorities to install about twenty-five street lamps in the principal streets and squares. This system is called Autolux. The cost of each lamp is $35.46 and $34.11 for a 1,000 and 500-candlepower light, respectively. Petroleum is used and one liter burns for three and one-half hours in the 1,000-candlepower lamp and six and one-half hours in the 500-candlepower lamp.

Tripoli was treated to a rare sight the second week of June by the illumination of the Italian flour mill. An English electric plant has been installed in this up-to-date establishment, and an electric lighting system is one of the privileges to be enjoyed if a concession can be secured for laying wires; but it is hardly possible that there would be subscribers sufficient to make it pay. The Banca di Roma is willing to erect electric lamps in different parts of the city free of cost and supply current, in order to supplement the Autolux system.

At the beginning of 1911 there were 1,217 wireless stations in the world, as against 755 at the beginning of 1910. Of these, 998 are on ships and 219 on land.

Telephony · Telegraphy and Wireless

TELEPHONE ECONOMY IN RAILWAY SERVICE.[1]

BY G. K. HEYER.

There are few, if any, recent developments in the railway field which in so short a time have created such a widespread interest as that of telephone train dispatching.

The telegraph made possible the abolition of the old-time interval and flag system of advancing trains and it was thought for many years possessed sufficient advantages to allow the other branches of our railroads to be developed to the greatest possible efficiency.

In the search for increased efficiency in the telegraph department, the telephone, thirty-one years after its invention, was turned to as offering the greatest possibilities. The one disadvantage of the telephone was that the requirements for commercial service have been such that there was little or no demand for a means of selectively calling any one station on a long and heavily loaded line. This disadvantage went the way of all others which stand in the way of progress, and there are at the present time several selective devices on the market which to a greater or lesser degree of efficiency answer the requirements. The standard telephone equipment and practice were also found in some features to be inadequate and there have been developed special circuits and apparatus which have greatly improved the service and increased the flexibility and efficiency of the telephone system.

The maximum efficiency of the telephone system has not, however, by any means been reached and there are under development and study at the present time many improvements, which indicate that there are no requirements for special service within the range of reason which cannot be met.

The advantages in favor of the telephone are that it is more flexible, quicker, safer and more reliable, and in addition makes possible better discipline and co-operation, as well as providing means for officials who are not familiar with the Morse code to exercise supervision and obtain immediate and accurate information in cases of emergency. The first installations made in the fall of 1907 were so successful that there are today in the United States and Canada approximately 48,000 miles of line, or nearly twenty per cent of the total railroad mileage equipped for telephone train dispatching, and the results obtained in every case sustain the judgment of the early advocates of the telephone.

Upon investigation in these days of scientific management, efficiency methods, etc., there stands out alone, far more important than any of the other advantages mentioned, although dependent in a great measure upon them, that of economy or the saving in dollars and cents which may be obtained by the use of the telephone.

Some of the factors which increase the traffic capacity and therefore make for economy in the telephone method of operation are:

(1) The time of calling stations, sending orders and receiving train reports is so greatly reduced (30 to 50 per cent), that the time gained is available for the dispatcher in better laying out his work, planning meeting points and handling the endless amount of detail which the position requires.

(2) Dispatchers are more efficient, due to the fact that they are relieved of the mental and physical strain attending the continual operation of the Morse key, which has a most damaging effect on the nervous system and frequently results in what is known as operator's paralysis.

(3) Through the use of the portable and siding sets, train crews may get into communication with the dispatcher and receive their advance orders directly from him. This has proven a most valuable branch of the service, especially in advancing freight trains which have taken a siding some distance from a station or tower; also, during the night, when on some roads part of the stations are closed. In this latter case the train conductors may be provided with keys and in that way have access to the dispatching telephone.

(4) The dispatch and exactness with which reports of progress on clearing up wrecks and repairing breakdowns is given to the dispatcher, thus allowing him to determine as to the handling of other trains, routeing them over other roads, etc.

It has been estimated by some of the roads that if, from a wreck or any other cause, traffic is held up, the additional expense incident thereto amounts to approximately $1,000 per hour. On the average, with the telephone system, wrecks are cleared up and traffic moving again in one-half to two-thirds of the time that is possible with the telegraph. A considerable saving, therefore, can be effected in these features of railroading.

It may seem strange to many, particularly those who have not yet installed telephone equipment, to hear that such a saving is possible. Of course, the nature of the equipment is such that the initial cost of telephone apparatus is much higher than that of the telegraph equipment. Further, the cost of maintenance is also considerably greater with the telephone. The saving, therefore, does not show on the books of the telegraph department, and in fact, this department shows a somewhat increased running expense. This increase is, however, insignificant when compared to the reduction in the cost of handling traffic. The traffic or transportation department is then the place to look for the real excuse for the expense of providing the telephone system.

The difficulty and expense incidental to securing from the records kept at the present time information from which may be computed reliable figures of comparative expense has undoubtedly delayed the preparation of such statistics. W. F. Williams, of the Seaboard Air Line, has, however, prepared information which shows that for one month on 150 miles of single track on his road, and with a 14.4-per-cent greater density of traffic for 1910 when the telephone was used, an average saving of one hour and twenty-six minutes in the running time of all through freights was effected over

1 Abstract of paper read at the convention of the Association of Railway Telegraph Superintendents, Boston, Mass., June, 1911.

the same period for 1908 with the telegraph. This is a saving in time of 10.9 per cent, and it will be seen instantly by computing the pay of the train crews, reduction of overtime charges, increased efficiency of the motive power, the reduction in fuel consumption, the increased speed of hauling perishable freight, etc., that on any road the telephone is a good investment.

It is not possible to give a general figure representing in dollars and cents the value of the time saved, on account of the conditions surrounding the various railway systems. If, however, the items as given are reduced to a monetary value on the individual system, the results obtained will be greatly surprising, and in the case referred to would represent approximately from $1,000 to $1,500 per month, or a yearly saving of at least $12,000. Comparing the cost of the telephone equipment based on $100 per mile, with the yearly saving in handling through freight traffic alone, it will be seen that the telephone will pay for itself the first year. In other words, the yearly saving amounts to about $100 per mile. Carrying this still further, we may say that for the 48,000 miles equipped there should be a difference in operating expense of approximately $4,800,000.

From information received from various sources, it is evident that on all roads hauling any considerable amount of through freight that the time consumed has been reduced since the installation of telephone equipment. For instance, on the Delaware, Lackawanna & Western Railroad, after the completion of the service between Binghampton and Buffalo, a distance of 206 miles, the through freights were run in approximately two hours less than was the rule when the dispatching was done by telegraph.

With the great increase in the number of telephones for commercial service and the consequent economies effected, it is only to be expected that the use of the telephone for railway service will gradually be extended to embrace many other branches. In fact this has already been done on some of the more progressive roads.

For handling message or other commercial and routine business between stations, the worth of the telephone has already been proven on several roads, and it is estimated that for this class of business one telephone circuit has the capacity of two telegraph circuits. On roads where the traffic is light, the dispatching and message work can be carried on over the same pair of wires.

In connection with manual blocking, the old telegraph wires may be utilized, thus providing a grounded block circuit, or, if convenient, a metallic circuit may be employed. Blocking sets or a switching mechanism may be provided to allow one set of telephone equipment to be used on the train, message and block wires, and to cut two blocks into one for night operation. The loud-speaking receiver is admirably adapted for this service and it is thought will ultimately replace the ordinary receiver for block work.

Another use for the loud-speaking receiver is in the dispatcher's office, where it may be connected directly to the train wire and relieve the dispatcher of wearing the head receiver at least a part of the time.

The train-order semaphore, one of the recent developments, which consists of a standard semaphore mast arranged for mounting the selector and telephone apparatus in a weather-proof compartment can be placed at any point along the line and the telephone and selector connected directly to the train wire.

The Mountain States Telephone & Telegraph Company.

The merger of the Colorado Telephone Company, the Tri-State Telephone & Telegraph Company and the Rocky Mountain Bell Telephone Company, under the name of the Mountain States Telephone & Telegraph Company, gives to the consolidated organization the telephone properties of six states and crosses the borders of two others. The company's territory comprises Colorado, Utah, Idaho, Montana, Wyoming and New Mexico, with toll lines extending into the surrounding territory. It occupies a region from Canada on the north to Mexico on the south—an aggregate territory of approximately 660,000 square miles, or more than one-fifth of the mainland area of the United States. The company has 61,100 miles of toll wire and 333,700 miles of exchange wire—a total of almost 400,000 miles—serving in the five states and one territory a population of 2,347,000, with 307 exchanges, to which are connected 162,060 stations.

The chief purpose of the merger was to bring under one management and ownership all telephones in the Rocky Mountain region, with the attendant economy and efficiency.

The management of the Mountain States Company is in the hands of the men who have made of the Colorado Telephone Company a successful enterprise. They carried it through the panic of 1893, the stress of 1903-4, and the crisis of 1907, without interruption of its dividends. They maintained such confidence in its stock that, while the price of other first-class securities fell far below former levels, Colorado Telephone suffered little.

E. B. Field is the president of the Mountain States Company, and has continued with him his full corps of assistants who brought the Colorado Company to a foremost place among public-service corporations.

Comparison of the growth in telephone business in the territory of the Mountain States Company with the growth of the Bell Telephone system in the United States shows that while the number of subscribers in the entire Bell system in 1910 was seven times what it was in 1900, and the miles of wire six times what it was in 1900, the number of subscribers in the territory of the Mountain States Company in 1910 was nine times the total number of subscribers in the same territory in 1900, and the total miles of wire was in 1910 nine times what it was in 1900.

These figures for the entire Bell system and for the territory of the Mountain States Company show that the telephone business, which eliminates time and distance, is making a phenomenal and continuous growth not paralleled in any other industry.

The principal offices of the company are in the Telephone Building, Denver, Colo., and the officers are the following, all of whom are familiar with the needs of the service: E. B. Field, president; Edward B. Field, Jr., vice-president and treasurer; J. E. Macdonald, secretary; E. M. Burgess, general manager; Roderick Reid, general auditor.

Nickel-First Telephones in Chicago.

There are over 30,000 of the nickel-first type of telephones now in operation in Chicago, in spite of some opposition which has been presented. With this type of instrument it is impossible to communicate with the exchange until the coin has been deposited, doing away with a good many useless inquiries as to time of day, etc.

A German Automatic Telephone Exchange.

The second city in the German Empire to be provided with an automatic telephone service is the residence city of Altenburg, in Saxony, which has been equipped for a capacity of 1,000 lines, about 700 subscribers being connected up. The first automatic telephone exchange was installed in Germany about two years ago at Hiddesheim in the Province of Hanover with about 1,200 lines in service. A modern German automatic desk telephone set, as utilized on the Altenburg system, is seen in Fig. 1. It may be stated that there is a long-distance service working in connection with the automatic system having 24 toll lines.

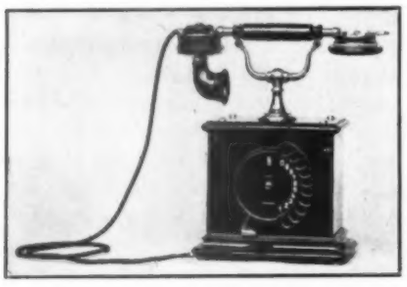


FIG. 1.—DESK SET.

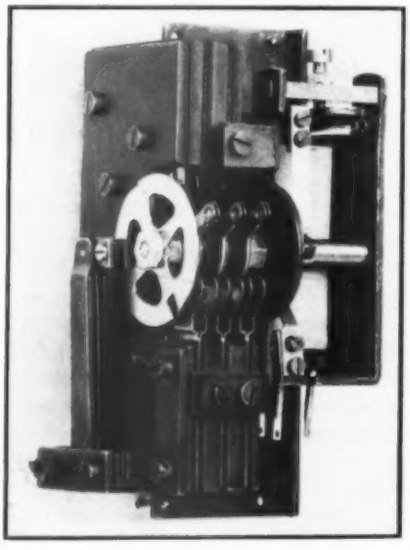


FIG. 2.—LINE SWITCH.

The Altenburg automatic exchange is provided with 1,000 pre-selectors, two sets of 100 group selectors each and 100 line selectors.

These instruments are mounted on racks and installed in a selector room measuring nine meters in length and six meters in width. A view of the frames is shown in the accompanying illustration, Fig. 3, while one of the line switches is seen in Fig. 2. At this exchange the storage-battery equipment is installed in a room measuring six meters square which also contains the switchboard and motor-generator sets for charging and ringing service. This exchange was completely equipped in four weeks by six men and the change was made from manual to automatic operation in three hours. The long-distance equipment includes ten trunk lines, the exchange being provided with a manual switchboard with positions for six operators handling twenty-four long-distance lines. The current is supplied by two sets of storage battery each having a capacity of 470 ampere-hours. These accumulator cells are charged through a regulating resistance from the city direct-current electric lighting circuit. The calling current is applied by motor-generator sets of one-fourth-horsepower capacity, operated from the same electric-lighting mains or from the battery equipment.

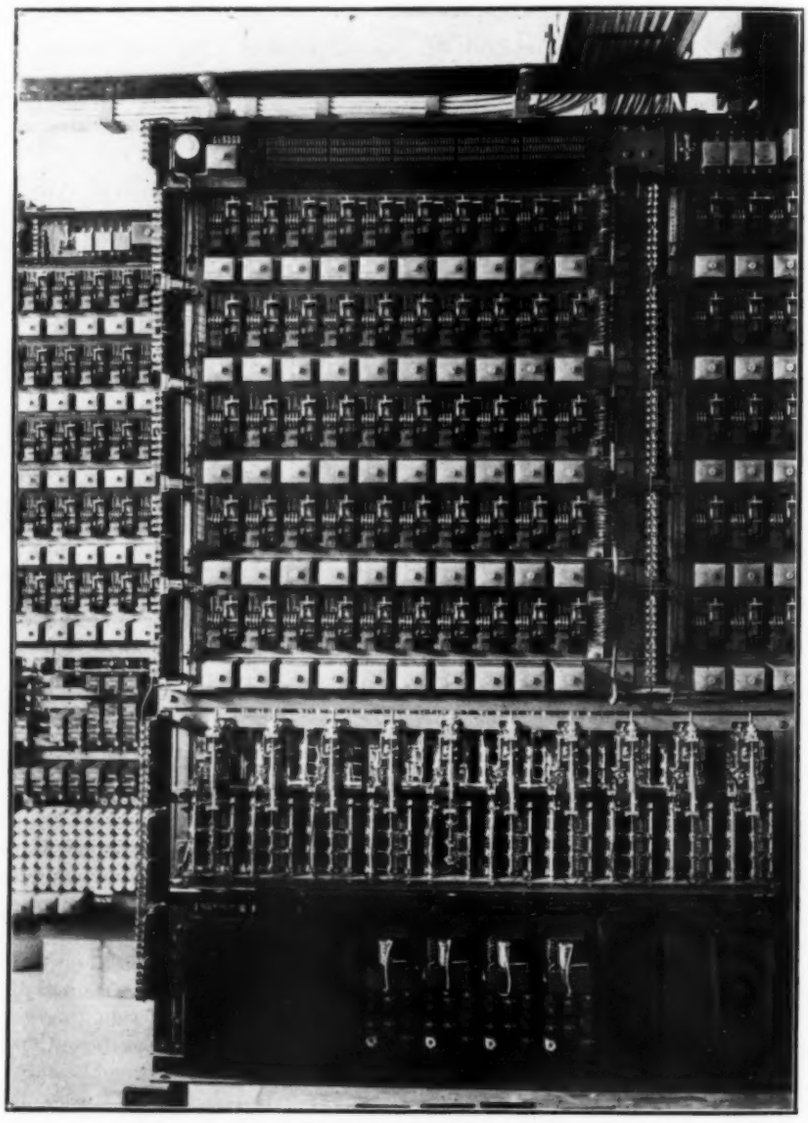


FIG. 3.—LINE SWITCHES AND CONNECTION BOARD.

A New Insulating Material.

A recent British patent of W. J. Reid describes a new insulating material. Paraffin wax is treated with a mixture of from forty to sixty parts of finely powdered cork and from sixty to forty parts by weight of boiled linseed oil, for such a time that it becomes viscous and will draw into threads when becoming cool. This mass can be molded while hot into any desired shape.

Industrial Power

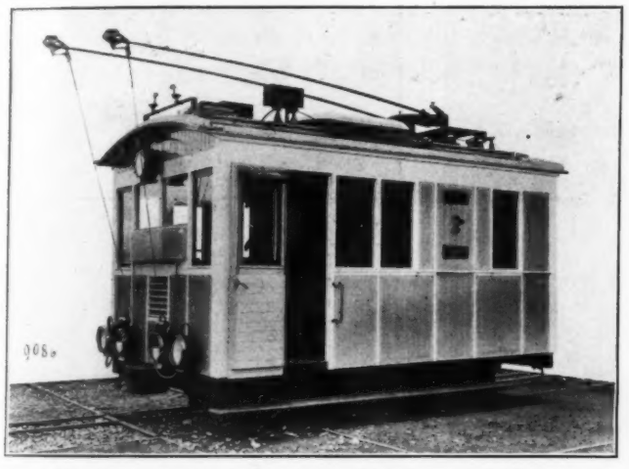
The Corcovado Electric Line.

Near Rio de Janerio a new tourist electric road employing the three-phase system is in very successful operation. It climbs to a point near the summit of Mount Corcovado, starting at an altitude of 130 feet, not far from the city, and reaching an altitude of 2,210 feet. The line is operated by the Rio Traction & Lighting Company and was changed over recently from a steam-traction line.

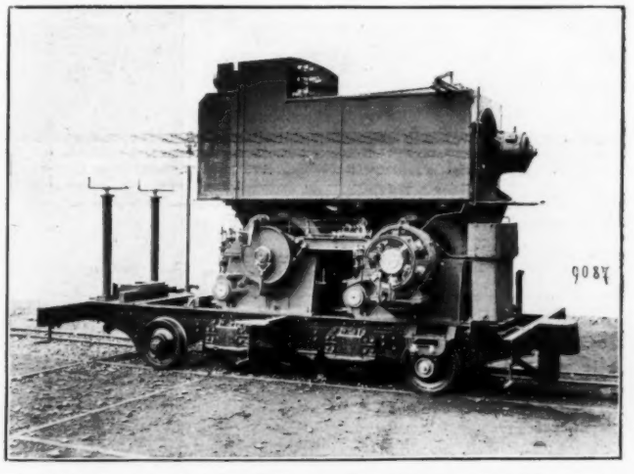
The locomotives are equipped with two 160-horsepower three-phase motors which take current from the double overhead line at 750 volts. Owing to the heavy gradients, a rack rail is employed, with a 39.37-inch gauge track. A set of gears having a ratio of 1 to 11.3 drives the pinions for the rack rail, each from a separate motor. The motors of the Oerlikon type have eight poles and run at 730 revolutions per minute. They are always coupled in parallel. One point to be noticed is the method of recuperating energy used when the locomotive is on the down-grade. In this case the three-phase motors are made to run as generators, and it is claimed that forty per cent of the power can be returned to the line. On the end of one of the motors is mounted a small six-pole exciter so as to enable the motors to generate three-phase current when on down grade. This also allows of using an electric braking method by employing a set of resistance coils. Such coils are mounted on the top of the truck in a large sheet-iron box, and a motor-driven fan at the back furnishes a strong air draft, this passing out by a flue which goes through the locomotive roof at the front.

A method following the general lines of the Jungfrau line in Switzerland was employed by the Oerlikon firm for the locomotive design. However, the locomotive does not bear any of the weight of the car, but is quite independent of it. To meet the present conditions while running on gradients up to thirty per cent, the truck is designed so that the weight is brought down as near the track as possible. The locomotive lies in the rear and propels the car up the rack instead of drawing it. Current comes from the overhead wires into a reversing switch and thence to two oil switches which are interlocked. These are operated by a lever and are combined with the brake system. From here the current goes to the motors. Either one of the motors can be cut out by a switch when this is needed. When running on down grade, a double-throw switch cuts off the motor fields from the line and puts them on the exciter circuit. A rheostat regulates the direct current from the exciter. This method of employing an exciter with three-phase motors has been patented by the Oerlikon firm, and a very regular and effective braking is secured.

Current comes from a substation on Mount Corcovado. The company operates a power network in the region supplied by a hydraulic plant over a 44,000-volt, fifty-cycle power line. A substation near town reduces this to 6,300 volts, and from this point a line runs to the substation on the mountain in which the voltage is lowered to 750 volts.



ELECTRIC LOCOMOTIVE OF THE MOUNT CORCOVADO LINE, RIO DE JANERIO.



CHASSIS OF LOCOMOTIVE—EXCITER SHOWN MOUNTED ON MOTOR SHAFT.

The total weight of the locomotive is sixteen tons when fully equipped, including the men. The electrical outfit weighs nine tons.

Electric Rack Railways in Switzerland.

In a paper read at the Zürich meeting of the (British) Institution of Electrical Engineers in July, entitled "Rack-Railway Locomotives of the Swiss Mountain Railways," Messrs. Weber and Abt reviewed the progress of electric locomotives in this class of traction and gave voluminous data relative to the various mountain installations.

At the present time Switzerland has a total of 120 steam and 45 electric locomotives arranged for rack operation. These locomotives operate over eighty-seven miles of road.

Electricity in Logging Operations.

Donkey engines converted so as to be operated by electric motors are the latest features of modern logging operations in the Spokane district and it is planned to extend their use to forests in other parts of the Pacific slope and intermountain country. It is predicted by engineers that the electrification of logging roads naturally will follow the adoption of electric logging on a large scale. The advantages claimed are the elimination of fire risk, the ease of power transmission and the use for large quantities of wood, now destroyed as refuse by many lumber mills in the Northwest.

The first electric "donkey engines" to be used in the Northwestern forests are at Potlatch, Idaho. They are built on lines originated by E. P. Barry, electrical engineer of the Potlatch Lumber Company, who, for experimental purposes, converted a steam donkey machine by gearing the motor to the hoisting mechanism. A motor-driven compressor supplies air for the signal whistle. The motor, specially built for severe service, is of 150-horsepower size, three-phase, 550 volt sixtv evcle running at 435 revolutions per minute, equipped with a current-limiting device. The apparatus handles an average of 35,000 feet of logs a day. Ten engines to handle from 300,000 to 500,000 feet a day will be installed to replace steam engines.

Should the tests prove successful it will be necessary to step up to the present voltage of 550 to a pressure which will allow of transmission over a large area. Transformers for this purpose, giving two voltages of 11,000 and 22,000 volts respectively, according to connection, will be used; 11,000 volts could be used until the requirements exceeded economical transmission at this pressure, when a change would be made by reconnecting the transformers for 22,000 volts. This would allow a twenty-mile radius for power transmission.

In operating motors it will be necessary to have the supply wires taken over ground from which the standing timber has been cleared, owing to the danger of interrupted service through trees falling on the line. This would be arranged by having the transmission lines always in the rear of the logger and consequently built over logged-off land. A portable substation consisting of one three-phase transformer of 150-kilowatts capacity would be placed at a convenient point for stepping down the voltage from 11,000 to 550.

From the substation a three-core steel armored cable will run to the motor on the logger, this cable being supplied in sections to allow the logger being warped out up to a distance of 1,800 feet from the substation. There is no doubt that within its capacity a motor will do all expected of it and still have a good reserve fund of energy for overloads.

Probably the greatest advantage of electric drive is the fact that a use may be found for the large quantities of fuel now burned uselessly as refuse by every lumber mill. Many thousands of horsepower are thus wasted every year, and it is surely time, in this era of conservation, to try to reduce this loss to a minimum.

Electricity Helps the Building Contractor.

The new Chamber of Commerce Building in Denver, Colo., is being built largely with the aid of electric power. Among the equipment being used is a six-horsepower direct-current motor for hoisting the steelwork, a fifteen-horsepower motor-driven concrete mixer, and a directly driven motor-operated brick hoist of three horsepower. In addition there is an electric-lighting installation being used in the dark basement instead of the customary gasoline flares, which have been proven inefficient and also a big fire hazard.

Unique English Electric Hoists.

An English four-ton suspension electric hoist with overwinding switch is shown in Fig. 1 about to raise two large castings. These electrc hoists are frequently used to replace hand-operated pulley blocks and are readily attached to existing beams, girders or chains.

These hoists are also employed to convey the hoisting motion of existing hand, air or steam-driven hoists to electric drive, it only being necessary to attach the necessary suspension link of the hoist to the existing lifting hook of the crane. This electric device is so constructed that it hangs plumb under all conditions of load and the head room required is reduced to a minimum. The four-ton hoist is operated by a four-horsepower motor which gives a lifting speed of twelve feet per minute. A novel two-ton electric traveling hoist of English construction may be noted in Fig. 2. This hoist will raise two tons with a 2.5-horsepower motor with a lifting speed of fourteen feet per minute, traveling at a speed of 150 feet per minute. It will be noted that pendent cord controllers are utilized, both automatic overtravel and overwinding switches being provided. This monorail hoist is similar in construction to the electric suspension hoist shown in Fig. 1, but the top plate is extended to carry a separate motor, which drives four traveling rollers through reduction gearing. By means of the safety overtravel a condition is met which is said to absolutely prevent the hoist overtraveling when the end of the track is reached.

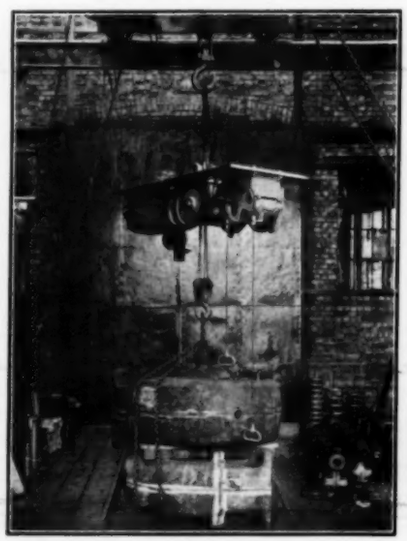


FIG. 1.—FOUR-TON ELECTRIC SUSPENSION HOIST.

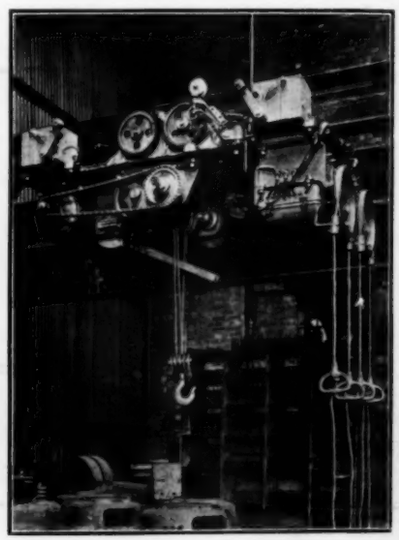


FIG. 2.—TWO-TON HOIST.

The Georgsmarienhutte Electrically Driven Rolling Mill.

A most successful electrically operated rolling mill is in operation at the iron and steel works of the Georg-Marien-Bergwerk und Hutten Verein and is shown in the accompanying illustration. Electric power is supplied, for operating the rolling mill of the Georgsmarienhutte, from a large gas-engine electric generating plant using waste gases as a fuel. The electric energy is distributed about the rolling mill to the various motors as direct current of 500-volts pressure. The main rolling mill which is electrically driven consists of rolls 900 millimeters in diameter and 225 millimeters in length. The live rolls conveying the steel to the mill are operated by two electric motors of forty-horsepower capacity each and having a speed of 510 revolutions per minute.

For driving the rolling mill proper a large direct-current shunt-wound motor is provided on a single base with two armatures and two fields, having a capacity of 7,000 horsepower. It has a speed of sixty revolutions per minute. This large double motor is mounted in a room by itself, its extended shaft passing through the side of the room and connecting with the main rolls as indicated in the accompanying illustration.

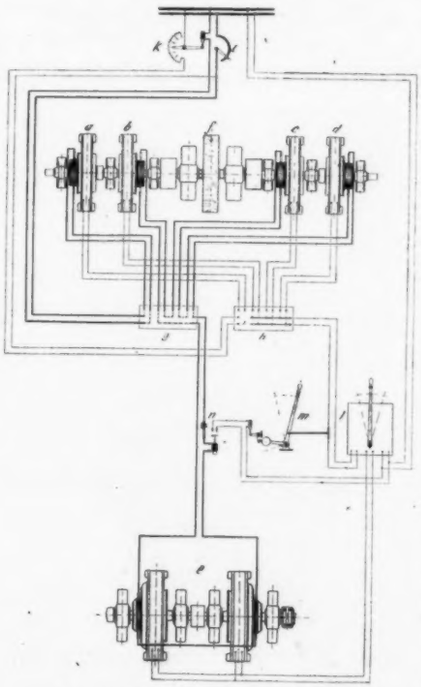


DIAGRAM OF CONNECTIONS.

For regulation and for producing the enormous turque necessary for driving the rolling mill without overloading the generating equipment a large fly-wheel motor-generator set is employed on the Ilgner system which has been developed for use with large mine hoisting motors at the main shafts.

This motor-generator set consists of four direct-current machines each having a capacity of 1,300 horsepower operating at a speed of 350 to 450 revolutions per minute. An enormous fly-wheel is mounted on the common shaft of these machines and gives up its energy to the dynamos at the time of maximum torque of the rolling-mill motor.

In the operation of the Ilgner motor-generator set one of the 1,300 horsepower machines acts as a motor while the other three act as a dynamo, being connected in series and each supplying current at a pressure of 500 volts so that the highest pressure received by the rolling mill double motor is 1,500 volts or 750 volts for each armature of this machine.

The motor-generator fly-wheel weighs thirty-five tons and has a speed of ninety meters per second. It was necessary to design a special coupling for connecting this fly-wheel with the four machines.

Electric Railways in Germany.

Of all the street railways of Germany in 1909, eighty-three per cent were electrically driven, says *Electrical Engineer*. Their total length was over 2,500 miles, and the number of cars was 10,800, of which 1,500 belonged to the Grosse Berliner Strassenbahn. The following table will be of interest, but it is restricted to towns containing over half a million inhabitants:

	Berlin.	Hamburg.	Munich.	Dresden.	Leipzig.
Millions of passengers	553	144	90	98	104
Receipts in millions of kronen	66	21.6	10.6	12.0	11.5
Line lengths in kilometers ...	399	189	76	135	116
Journeys per inhabitant	184	148	168	190	208
Receipts per passenger in heller	11.9	15.0	11.8	12.8	11.0
Meters of line per inhabitant	0.132	0.195	0.141	0.26	0.23

Fireproof Varnish for Insulation.

According to Debauge et Cie's French patent No. 418347, a solution of cellulose acetate in tetrachlorethane and pyridine is an excellent substitute for rubber varnish for dynamo wires. Its viscosity can be increased if necessary by the addition of hexachlorethane or aldehydes of the terpene series.

This same varnish can be used for flame-proofing textiles and for insulating tinfoil in electrical condensers.

TWIN MOTORS FOR DRIVING ROLLING MILL.

ELECTRICALLY DRIVEN ROLLING MILL.

New Electrical and Mechanical Apparatus and Appliances

Composite Telephone Sets.

The telephone, within recent years, has become extremely useful and important in railway work as an adjunct to the telegraph in relieving overloaded telegraph lines. The use of the so-called composite telephone, namely, a telephone that operates simultaneously with the telegraph over a grounded telegraph line, is the most economical method of increasing a wire's capacity.

The No. 1312-A composite telephone, manufactured by the Western Electric Company, is classed among the most efficient apparatus of this character on the market. These telephones are in extensive use where additional wire mileage has been required, and yet the expense of stringing the additional wires themselves was not warranted. For such cases, the composite system possesses marked advantages in first cost, operating cost and maintenance. Its installation requires no additional line construction; its operation necessitates no increase in the operating staff, and the absence of outside construction simplifies the maintenance problem. Signaling with a composite telephone is infinitely more effectual than with the telegraph.

The signaling apparatus used with the No. 1312-A telephone set and the No. 1314-A portable composite telephone, calls between stations by means of what is known as a howler. When one operator wishes to call another, he presses a button in the side of the telephone set. This action automatically starts an interrupter working, which sends out high-frequency signaling current over the line and causes the howlers at the other stations to give the desired signal in a loud whistle or shriek.

No change in the telegraphic apparatus or its operation is necessary to adapt the system to telephone operation also. Each telegraph station is merely bridged with a condenser and a resistance and the telephone apparatus is connected between the line and ground. A condenser in each telephone set prevents the telegraphic current from passing through this apparatus to ground.

It is easily possible to talk on a composited line of this character while telegraph signals are passing over it, without any interference whatever. The

PORTABLE COMPOSITE TELEPHONE SET.

length of telegraph lines over which such service can be given is more or less limited. The most satisfactory operation is obtained where the telegraph is used for through business and the telephone for local business, on the same line. On a short line, service will

WALL-TYPE COMPOSITE TELEPHONE SET.

be better and more stations can be operated than on a long line, and the usual maximum limit is generally taken at 125 miles of No. 8 BWG iron wire equipped with seven telegraph stations and five telephone stations.

On some railroad systems, through lines are composited over different sections, as for instance, in the case of a through telegraph circuit extending from New York to Wilmington, N. C., which is composited between Richmond, Va., and Rocky Mount, S. C. It can thus be seen that the section of line between these two points is serving a double purpose simultaneously, and thereby saving the expense of installing another circuit between these points.

Central Station Adds Equipment.

With the more prevalent use of electric light and power in Evansville, Ind., the Evansville Gas & Electric Company has found it necessary to increase its generating facilities. In previous enlargements at this station, the turbine-type equipment has invariably been given preference, the plant, up until a short time ago, comprising two vertical turbines and one Allis-Chalmers unit. Due to the promising growth of its electrical load, the operating company recently decided on a substantial addition to its present equipment, and accordingly placed an order with the Westinghouse Machine Company for a 1,600-kilowatt turbine of the improved high-speed, double-flow type. The turbine will follow the familiar Westinghouse construction, partial expansion of steam taking place through a high-pressure impulse section, further expansion to a twenty-eight-inch vacuum being then effected through Parsons blading of standard design. The electrical end of the unit comprises a Westinghouse generator normally rated at 2,000 kilovolt-amperes, delivering three-phase, sixty-cycle current at 2,300 volts.

Advertising by Moving Pictures.

A manufacturing company which extensively advertises its product promotes publicity by means of a moving picture machine, carried about on a motor truck. In order to be sure at all times of a source of current supply a generator has been bolted to the truck and so fixed as to be driven by the automobile engine, while the automobile stands at the place of exhibition.

Installations and Tests of Thomas Meters.

In the issue of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for March 4, 1911, there appeared an article describing the Thomas meter, an electrical device for measuring the flow of gas. Two noteworthy installations of this meter have subsequently been made and the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., the manufacturer, has conducted a number of tests under actual service conditions that present some interesting results.

Through a single thirty-inch diameter main leading out to the distributing lines from the pumping station at the West Side plant of the Milwaukee Gas Light Company, passes all of the gas supplied to the city of Milwaukee for heating and lighting purposes. A Thomas meter in a single unit is measuring this gas and is giving on the pumping-station floor continuous records, both graphical and integrated, directly in "standard cubic feet," of the total gas flow through the main.

When it was decided to attempt this measurement with a Thomas meter the only available space in the pipe line for the meter casing was a vertical section of thirty-inch pipe, five feet ten inches in length, located directly between two elbows. A casing was designed which occupies no more space in the pipe line than did the pipe which it replaced, and from which the inner barrel with the heater and thermometer units can be very quickly removed for cleaning.

As it was desired to have the recording instruments on the pumping-station floor where space is very limited, the heater rheostat and control mechanism were separated from the recording panel and located in an out-of-the-way place in the basement. This rheostat is 34 by 42 by 40 inches. The recording panel, having mounted on it the recording instruments and control switches, is only 36 by 44 inches and is located on the wall where it can be conveniently operated from the pumping-station floor. Thus has been installed in a plant already built and in operation a meter that will measure the total output of the plant and which occupies very little space, almost none at all, in fact, that could have been utilized for other purposes. This installation is a very striking example of the flexibility of location of parts of the Thomas meter and of its enormous capacities compared with the space which is occupies.

METER RECORDING PANEL, MILWAUKEE PLANT.

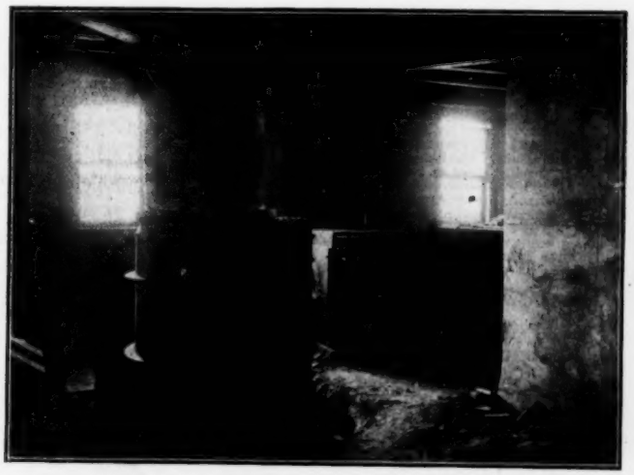
The meter has a maximum capacity of 3,000,000 cubic feet of free gas per hour and an accurate minimum capacity of 50,000 cubic feet. Although the pressure and temperature of the gas flowing through the meter vary somewhat, the graphical instrument traces a continuous curve showing directly in standard cubic feet the rate of flow of gas at any time, the maximum and minimum peaks, their values, the time of day and season at which they occur, etc. From the integrating instrument the total flow during any period of time is obtained directly in standard cubic feet by subtracting the reading taken at the beginning of the period from that taken at the end.

It is impossible with this installation to check the meter readings with any other type of meter; but the accuracy of the Thomas meter for the measurement of low-pressure air and illuminating gas has been thoroughly established by a discussion of the results of tests obtained during early development work with both air and gas, with the meter in series with a wet displacement meter in the Third Ward plant of the Milwaukee Gas Light Company. The following table shows briefly comparative results from the two meters with illuminating gas. During this test the average temperature of the gas was fifty-nine degrees Fahrenheit, and the average pressure 30.24 inches of mercury. The figures are given in cubic feet per hour under these conditions.

Wet Meter	Thomas Meter
17,350	18,250
32,640	33,100
45,200	46,000
61,200	60,600
75,600	73,200
84,960	84,900
90,240	89,300

The second notable installation of Thomas meters is at the Brave pumping station of the Peoples Natural Gas Company of Pittsburg. A Thomas meter is installed here for the continuous measurement of natural gas between the wells and the pumps. This meter

METER RECORDING PANEL TO RIGHT OF SWITCHBOARD—BRAVE, PA.



THOMAS METER CASING AND HEATER RHEOSTAT—MILWAUKEE PLANT.

gives in the office of the pumping station a continuous graphical record as well as integrated values of the flow of gas through the line in which it is installed, directly in standard cubic feet, at 15.025 pounds absolute pressure and sixty degrees Fahrenheit, although the pressure of the gas varies from 50 to 200 pounds gauge, and the temperature varies according to the weather conditions.

This installation affords an unusual opportunity for checking the accuracy of the meter on account of the very wide variations in pressure and rate of flow of the gas through the line in the ordinary operation of the system, and also because there is installed at Bula a very complete and thoroughly calibrated pitot-tube station, one tube of which is in the same line with the Thomas meter. The two meters can thus be run in series, although they are separated by about one and one-half miles of ten-inch pipe. Readings of pressure and velocity head are taken on the pitot tube every fifteen minutes night and day, and from these readings values of gas flow in standard cubic feet are obtained by the use of carefully prepared tables. As these tables reduce the pitot-tube readings to the same standard units in which the Thomas meter is designed to read, the results are directly comparable.

The following is a summary of results of tests conducted at the gas plant at Brave, Pa.

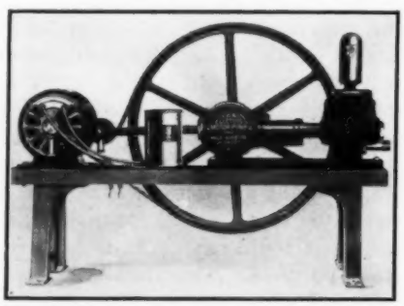
Twenty-two-Hour Test, April 9 and 10, 1911.	
Total standard cubic feet of gas for twenty-two hours by Pitot Tube	8,784,800
Total standard cubic feet of gas for twenty-two hours by Thomas Meter	8,764,000
Specific heat of standard cubic feet of gas from analysis assumed for design	.02609
Specific heat of standard cubic feet of gas from analysis of sample taken during test	.02609
	0.2% difference.
Endurance Test April 17 to June 3, 1911.	
Total standard cubic feet of gas by Pitot Tube	337,546,182
Total standard cubic feet of gas by Thomas Meter	336,732,018
	0.2% difference.

These two tests, one for a comparatively short period of time under quite steady conditions of flow, pressure, and temperature, the other for a long period under widely varying conditions, have proven conclusively that the Thomas meter will give direct results in standard units continuously and automatically, under severe commercial conditions, that compare most favorably with those obtained by very careful and frequent observations on pitot tubes and the use of tables that have been very accurately checked by the most careful calibrations.

Motor-Driven House Pump.

One of the problems that often confronts the property owner in rural and suburban districts is a troublesome and more or less crude water system. The Vaile-Kimes Company, of Dayton, Ohio, are manufacturers of an electric-motor pump which, when installed with a compression, or pneumatic tank, makes an independent reliable automatic water system for all purposes. It pumps the water direct from the cistern, well, lake or stream into a tank under pressure and from there it is distributed to the house.

In cities where water rates are high or where the pressure is low, and where homes are supplied with electricity, the "V & K" pump forms an efficient and inexpensive means of water supply. It is of sufficient capacity to furnish the average suburban home



MOTOR-DRIVEN HOUSE PUMP.

with water under pressure for bath rooms, kitchen, laundry, etc.

The power is obtained from a one-eighth-horsepower Westinghouse motor, used so extensively for the operation of small machines.

The first cost of this outfit is comparatively small considering its capacity and efficient operation. The operating expense is said to be very slight as the motor is so well designed and built that the cost of current consumed does not exceed two cents an hour.

An automatic switch, governed by the water pressure in the system, controls the operation of the motor. This switch starts the motor automatically when the pressure falls to a given point and stops the motor when the maximum desired pressure is reached. No attention is therefore required to keep up the water supply. The pump is belt driven and is equipped with an automatic belt tightener which keeps the belt always tight. A large air chamber makes the discharge smooth and uniform.

Submersible Electric Motor.

As the outcome of a series of severe practical tests of the Macdonald submersible electric motor, which have just been carried out at the engineering works of Messrs. Gwynne, Limited, Crisp-road, Hammersmith, in the presence of a party of British and other government experts and engineers, something in the nature of a revolution is promised in present methods of mine pumping and salvage work. In the history of electrical industry nothing perhaps is more remarkable than the evolution of the electric motor, the improvements in which have been consistent and continuous from Davenport's day up to the present time. The construction, however, of a motor which will go on doing its work equally well on land or sunk under water is a development which may fairly be described as creating a new era in this special branch of an industry which owes so much to patient scientific research and endeavor.

The Macdonald submersible motor is at present made in three types, two for mining and salvage work, and a third for use on board ship. For the mining type it is claimed that it can be employed for working coal-cutting machines without the slightest risk of sparking, while with regard to salvage work it is urged that it opens up possibilities such as have never hitherto been contemplated and can be made the means of salving wrecked vessels, which under existing conditions, must be abandoned to the mercy of the seas. The demonstration at Messrs. Gwynne's works of the type under trial amply justified these claims. Though sunk to a depth giving a very heavy pressure per square inch, it emerged with complete success from a test at once critical and exhaustive, the ten horsepower motor discharging 30,000 gallons per hour to a height of thirty feet without a single hitch or mishap of any kind during several days of continuous observation. The action of the motor is direct and self-contained, and thus in its utilization on board ship suction hose and priming are dispensed with; while for mining use it promises to eliminate practically every source of danger.

It is well known, of course, that efforts have been made for years past to inclose motors with different types of castings so as to make them perfectly water-tight and, at the same time, air-

tight, but in every case hitherto, so far as is known, the heat generated has set up condensation and destroyed the armature. Thus until the advent of the Macdonald motor, there was no electric motor in the world, says the inventor, which could be satisfactorily worked under water. In the type A machine for mining work, the motor is connected to a centrifugal or other type of pump of any dimensions and on the same bedplate or foundation, any sized air compressor can be fitted and connected with the motor. Air pipes can then be led to any part of the workings, however distant, and the operation of a switch at the pit mouth will supply air to any particular place in the mine, although the motor and compressor may be many feet under water. At the same time the pumps can be kept running full bore.

Under ordinary conditions the compressor can be utilized to work every kind of pneumatic rock or other drilling appliances, and will keep the air perfectly pure in confined spaces where there is the smallest possible outlet.

Another important feature of this plant is that while hitherto it has been impossible to operate electric drills or other electric tools in damp or wet places, the new electric tools constructed with a smaller type of the submersible electric motor can be manipulated under running water or even entirely submerged, and will run direct from the main motor at any distance from it, a feature which will be easily recognized as a great advance and improvement on the present electric tools. The plant is placed at the bottom of the mine or in any convenient position, and the pump need have no lift, simply a delivery to the next stage. In all cases where possible, the pumping set and motor is submersed in water and therefore no suction hose is necessary, simply a delivery pipe, and no priming is required. The pump being under water, is always primed ready to start immediately the current is switched on.

In a flooded mine it is only necessary to suspend the pumps by ordinary chain slings from a tackle overhead and immerse them a few feet under water. They require no staging or platforms, and there is no vibration. Extra lengths of delivery hose are connected up as the water is pumped out and the pump lowered down. The recent terrible colliery disasters demonstrate the value of a machine of this description, whereby pure air can be delivered to any part of the mine and the deadly gas pumped out at the same time.

Then again, as already mentioned, the submersible motor can be employed for working the coal-cutting machines in mines without the slightest danger of any sparking arising from it. Both the motor and switches controlling the cutting gear are simply immersed in a tank of water, covered in to keep out the coal dust, and the whole arrangement placed on a trolley.

Taking the hypothetical case of a large vessel standing on a rock-bound coast, exposed to the sea and full of water from end to end, the invention demonstrates in striking fashion the utility of the submersible motor as compared with the old system. The vessel, in normal circumstances, would be an apparently hopeless case for salvage, as it would involve duplicate sets of pumping plant, with the risk of their being washed away on the first approach of bad weather. Submersible motors and pumps could be lowered down to any decks below water, placed in position by the diver, and worked from the dynamos of the salvage steamer either alongside or from any distance away. In the event of bad weather coming on, it would be only necessary to disconnect the wires, and the pumps, being under water, well down in the hold of the ship, would be in comparative safety, and could be started again immediately the weather moderated simply by connecting up the wires. In the majority of cases it would only be necessary to suspend the pump from the steamer's derricks and lower them into the water without coupling up any suctions. Pumping could be commenced immediately after one length of delivery hose was attached, the whole operation being performed in a few minutes. The pumping sets are also arranged for working from the ship's dynamos if available, or from portable oil-driven dynamos on board the wrecked ship.

So far as mining work is concerned, the Macdonald motor is calculated completely to nullify the agitation against the utilization of electricity in coal-cutting for the motor can be placed in a tank of water and attached to the machine and, being submerged, wholly eliminates the possibility of sparking. In cases where mines are flooded by a sudden inrush of water which would render ordinary motors useless the Macdonald machine would prove of inestimable value; while for affording auxiliary pumping power in battleships, for electric boat-hoists, winches and capstans, and for delivering pure air to mines while pumping out deadly gases results of an equally satisfactory character can be obtained.

Electric in Record Run.

An enviable record was made by an electric roadster in the recent Indiana State reliability run through four States, held for Indiana cars. The electric was entered by the Waverley Company, of Indianapolis, who furnish a graphic account of the trip.

"No advance preparations were made; no agents were sent along the line; no arrangements were made for charging.

"Half a day before the tour began a roadster was taken right out of the garage, equipped as it would have been for a run to the Country Club, given a slight extra charge of the batteries and sent on its way.

"Terre Haute was the first stop, 82.5 miles from Indianapolis. After an extra charge the car went on to Paris, Danville and then to Decatur, making 157 miles in a single run. Springfield, St. Louis, Quincy, Burlington and Davenport were reached without mishap to the car.

"A delay was caused at Davenport by an accidental disconnection in charging, but the Waverley caught its rivals at Dubuque. Here an extra charge was required, owing to the severe strain on the batteries, and the Waverley parted company with the rest of the cars at this point.

"Between Dubuque and Rockford a heavy storm was encountered and the worst hills and roads on the route. The amperage draw often ran up to 150 amperes for ten or fifteen minutes at a time, but the plucky drivers kept the car steadily plugging on its way.

"A short rest was taken at Chicago, and the trip to Indianapolis was covered in twenty-three hours. The total running time of the tour was 124 hours, as compared with 73 hours for the swiftest of the gasoline cars that made the trip.

"When the time spent in charging is taken into account, and when all the conditions of roads and weather are considered, it will be seen that this Waverley electric roadster has made a trip quite unparalleled in the history of automobile tours."

Large Transformers.

About two years ago the General Electric Company shipped to the Great Western Power Company a number of 10,000-kilovolt-ampere transformers, these units being the largest manufactured at that time. Since the installation of these units, other operating companies have followed the example set by the Great Western Power Company and, at the present time, quite a number of transformers of this exceptionally large capacity are in operation at various places.

Still larger units have recently been shipped by the General Electric Company to the Shawinigan Power Company, at Shawinigan Falls, Canada. This shipment included four three-phase water-cooled units designed for operation at a frequency of sixty cycles, two of them having a normal load capacity of 14,000 and the remaining two of 12,500 kilovolt-amperes. The 14,000-kilovolt-ampere transformers will step the potential up from 6,600 volts to approximately 100,000 volts for long-distance transmission. All four transformers have the same overall dimensions, occupying approximately 23 feet by 8.5 feet floor space and being eighteen feet from the floor to the top of the high-tension terminals. The construction is exceedingly substantial, practically the only castings are the base and cover, the walls of the tank being made of steel plate. On account of the great weights necessarily dealt with, the supporting frame work of the coils and core is built up of heavy I-beams, the general appearance of the frames closely resembling the construction used in large locomotive frame work.

These transformers were designed to withstand a high-potential test of 270,000 volts from the high-tension winding to all other parts. Oil-filled entrance leads are employed and these also were subjected to this high-tension test. Although the striking distance of this test voltage in clear air is nearly 2.5 feet, it is noteworthy that, when applied to these transformers after dark and with all lights turned out, no corona was visible.

There appears to be no practical limit in the design of transmission transformers either from the standpoint of capacity or voltage, as both of these conditions are limited by other features—the transmission lines being the limit for potential and the transportation facilities for the size of the units.

A New Direct-Reading Ohmmeter.

The instrument shown in the accompanying illustration is an improved resistance-measuring apparatus for the rapid and direct measurement of resistances which fall within the range of the slide wire or Wheatstone bridge to a commercial degree of accuracy. It fulfills the requirements of manufacturers, electricians, testing engineers, and those who require an instrument giving results without calculation. The manipulation consists of closing the battery and galvanometer keys and rotating the index until the galvanometer indicates a balance. The unknown resistance is

DIRECT-READING OHMMETER.

then read from the scale without the necessity of referring to a table of values.

In order to give maximum accuracy multipliers are provided so that a balance can be obtained in the mid-part of the scales for all resistances ordinarily measured in actual practice.

A contained battery adapts it for portable purposes as well as bench use in manufacturing establishments and repair shops. The portable feature makes this instrument applicable for use in car barns for checking resistances in the car circuits, etc.

Provision is also made for connecting an external battery. The scale is engine divided on brass and is therefore not subject to the defacement of paper scales. The convenience of manipulation is very striking since it is only necessary to rotate the index to balance. This feature adapts it for use by those not skilled in the use of Wheatstone bridges.

The construction is substantial throughout so as to insure permanancy. The galvanometer in the ohmmeter is a sensitive D'Arsonval type as used in the high-grade portable testing sets manufactured by Queen & Company, Inc., Philadelphia, Pa., by whom this new ohmmeter is also made.

Electrics versus Horses.

According to the *Elec-Tricks*, a little monthly published by the General Vehicle Company, electric trucks saved something more than $10,000 a year for the White Express Company of New York and did better and more reliable service. The figures, which appear to have been carefully compiled, are worth studying.

The magazine states that the five 3.5-ton trucks purchased by the company replaced twenty-five horses, the maintenance of which cost $105 a day (including rent, feed, bedding, shoeing, stableman, veterinary, etc.); also ten wagons, with five men and five helpers at $21 a week, for one driver and one helper. On long routes, such as Coney Island, the two-ton truck replaces one wagon and four horses used in alternate daily relays. The figures on which the economies are claimed are as follows:

HORSE-TRUCK EQUIPMENT.

Former horse equipment, five electrics replacing 25 horses at $250 each	$ 6,250.00
Additional investment in horses to balance ten-year life of electric (estimated life of each horse, four years).	7,812.50
Total original investment	$14,062.50
Interest at 4 per cent	625.00
Depreciation at 10 per cent	1,406.25
Ten trucks at $500 each	5,000.00
Interest at 4 per cent	200.00
Depreciation at 8 per cent	400.00
Ten drivers at $16 per week	8,320.00
Ten helpers at $5 per week	2,600.00
Maintenance of horses at $1.05 per day each	9,581.25
Insurance (estimated)	250.00
Stable men, 4 at $10 per week	2,080.00
Rent (estimated)	2,400.00
Total	$46,925.00

This table includes no investment in or depreciation of harness.

ELECTRIC-TRUCK EQUIPMENT.

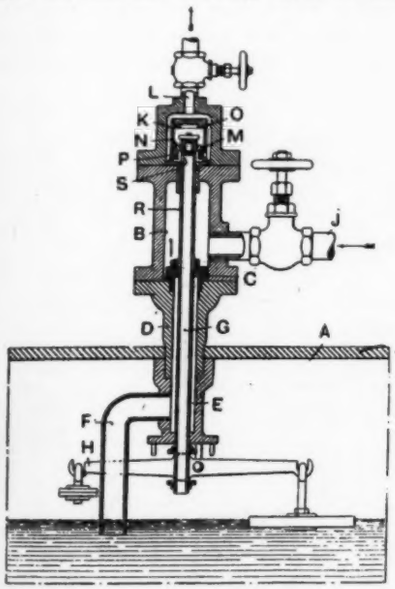
Five electric trucks	$20,000.00
Depreciation at 10 per cent	2,000.00
Interest at 4 per cent	800.00
Liability insurance	500.00
Fire insurance	190.00
Five drivers	4,160.00
Battery repairs and renewals	1,900.00
Tire repairs and renewals	1,875.00
Chains, gears, bearings, etc.	750.00
Current	2,000.00
Battery man	730.00
Assistant	325.00
Washer	162.00
Rent	1,000.00
Lubricants	45.00
Total	$36,437.50

Swiss Water Power.

It is stated that the horsepower obtained from rivers in Switzerland amounts to a greater total than in any other country. It is estimated at 1,200,000 horsepower.

Feed-Water Regulator for Steam Boilers.

A design of feed-water regulator for steam generators, of the type in which a float-controlled valve spindle operates or controls both the water inlet to the boiler and the steam supply to the feed pump, is shown in the accompanying sectional view. A represents the boiler, B a chamber containing the water-regulator valve C, this chamber being supported on a hollow block D secured in an opening in the boiler shell; E is a chamber attached to the block D inside the boiler, and having a pipe F leading from its bottom part and extending below the normal working level of the



FEED-WATER REGULATOR FOR STEAM BOILERS.

water in the boiler; G is a spindle operated by a float-controlled lever H to actuate the valve C, when required, to admit water from a branch feed pipe J past the valve C and through the hollow block D, chamber E, and pipe F, to the boiler. Over the chamber B, containing the water-regulator valve device C, is a second or auxiliary chamber K communicating, in this instance through a pipe L, with the steam inlet of the feed pump. The float-controlled valve spindle G is hollow and is connected at its upper end to a hollow extension R, the lower end of which has formed integrally therewith the valve C, the upper end of the extension extending upwardly into the auxiliary chamber K, and having secured thereon an annular cap or valve M controlling ports P in a casing O. Suitable ports S in the upper end of the extension R place the interior of the valve M in communication with the steam space of the boiler through the hollow extension and hollow spindle, and the valve M has ports N therein to permit steam to pass to the upper side thereof to put the valve in equilibrium and thus enable it to be easily moved to cover or uncover the ports P.

So long as the water level in the boiler remains normal the annular cap or valve M is held in a position to maintain the ports P closed and communication between the steam space of the boiler and the pipe L, leading to the feed pump, is cut off. When the water level drops below the normal the valve spindle G is moved vertically upwards and, simultaneously with the opening of the valve C to admit water to the boiler, raises the valve M and permits steam to pass by way of the ports P, chamber K, and pipe L to the feed pump, the volume of steam permitted to pass to the pump being regulated by the action of a float lever.

With the arrangement described, which is the invention of Messrs. Lees, Bedford Street Brass Works, Halifax, the supply of steam to the feed pump is, it is claimed, efficiently controlled in proportion to the work the pump is called upon to do, and if no water is required to be fed into the boiler the pump remains at rest.

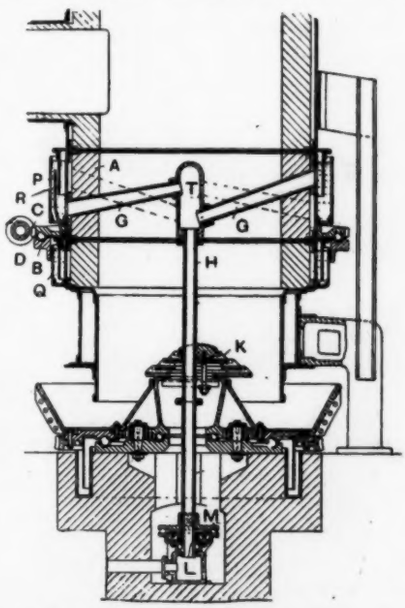
Lamp Company Erects New Office.

On or about September 1, 1911, the offices of the Sterling Electrical Manufacturing Company, of Warren, O., will be transferred to the company's new office building on West Summit Street. Every facility for handling with maximum accuracy and dispatch, the executive, clerical and correspondence work of a large and expanding incandescent-lamp business has here been provided.

The sales force of the Sterling Company, including the various district managers, the traveling representatives, and the home-office employees have been spending a most profitable week in their camp at Riverside Farm, on the Mahoning River, Warren. Daily conferences on the technical and commercial aspects of the incandescent lamp, interchanges of sales experiences, addresses by lamp manufacturing experts and illuminating engineers, present as the company's invited guests, have put the men in the best possible shape for the strenuous work of the coming season.

Fuel-Agitating Device for Gas Producers.

A design of gas producer of the type in which the fuel is agitated during the operation of the apparatus by means of hollow arms extending diametrically across the producer and fixed to a rotary section of the shell, the burning of these arms being guarded against by means of water supplied to a tank on the apparatus casing, is shown in the accompanying cut. The cylindrical casing A is mounted on the ball-bearing B. The apparatus is driven through the worm-wheel C and worm D. The arms forming the agitator mechanism



GAS PRODUCER ARRANGED WITH FUEL-AGITATING DEVICE.

are arranged in a rotatable casing A, two or more hollow cast arms G, being arranged opposite each other and at different heights. The arms can likewise be arranged in such manner that their planes of rotation intersect, as shown in the drawing. The tube H passes through the grate K beneath which it is carried through the stuffing-box L and is mounted in the ball-bearing M. The cold water issues from the arms G into a water tank P, arranged concentrically with the shaft H, and from this tank the water passes by means of a pipe R into the second tank Q, the two tanks forming a gas-tight seal between the gas producer and the casing A. The arrangement is the invention of Gutehoffnungshutte Aktienverein fur Bergbau und Huttenbetrieb, Oberhausen, Rheinland, Germany.

The Acme Steam Engine.

The Acme steam engine, formerly manufactured by the Rochester Machine Tool Works, of Rochester, N. Y., and now by the Sterling Machine Company, of Norwich, Conn., is one of the best known small steam engines on the market. It has been manufactured for the past twenty years and improved from time to time to meet the demands of the day for a rugged, simple and economical unit. The manufacturer has recently added several interesting features to this engine and a general description is therefore timely.

These engines are of the vertical two-cylinder single-acting inclosed type with a balance rocking valve, splash lubricated. They are built in three series of sizes, the small series having a two and one-eighth, three, three and five-sixteenths and three and one-half inch stroke. These small engines are identical in external appearance. The middle series has a three and five-sixteenths, four, four and nine-sixteenths, and five by five-inch stroke. These four sizes are also identical in external appearance and practically of the same weight. The large series of three engines is five, six and seven-inch, being also of the same external size and general appearance. This range of sizes covers all the applications to which these engines are especially adapted. Because of the extreme simplicity of construction, the type of valve which adjusts itself to wear, the large bearing surfaces which are thoroughly well lubricated at all times by a splash of oil, they are especially well suited to drive mechanical stokers, for direct connection to small gear-driven pumps, for driving rock drills and small friction hoists, any variety of belt or direct-driven pumping machinery for contractors or irrigation purposes and for small plants such as laundries, creameries, etc. They have also been adopted in a number of instances to marine service such as lighting, driving ammonia compressers, ventilating fans, etc.

The character of internal construction is especially interesting, showing as it does the influence of automobile engine practice in many of the details. For example, the crank shafts are drop forged and ground to very accurate size, the connecting rods are of the popular I-beam section, bushed with bronze at both ends, the bearing cap on the crank-end being held in place by castle nuts and cotter pins as is common in automobile work. The piston rings are of the diagonal-cut type, two being placed above the wrist pin and one below. These rings are re-turned after cutting and ground to accurate size. The valve is a simple one-piece casting which is ground on the outside to fit a very accurately bored chamber and is fastened to the extended valve stem with a cross key in just the same way that the ordinary Corliss valve is fastened. A further point of considerable interest is the automatic cylinder relief valves which are built into the cylinder heads to relieve any water that might otherwise cause damage. The governor is of a very simple type, consisting of four main pieces. The action of the weights is modified by means of a hardened roller which travels in a milled arc.

The whole of the governing mechanism is contained in an oil pocket, only the pin to which the lower end of the valve rod is connected being extended through. Also inasmuch as this mechanism is on the outside of the fly wheel, it is very readily gotten at. There are but two grease cups requiring attention, all other surfaces being amply lubricated by the internal splash. Provision is also made in the base of the engine for the elimination of the condensation which may collect and the leakage from the valve-stem stuffing box falls down into the engine base through the vent pipe at the end of the engine. The entire series of engines are built with new and accurate jigs on the interchangeable plan.

ACME STEAM ENGINE.

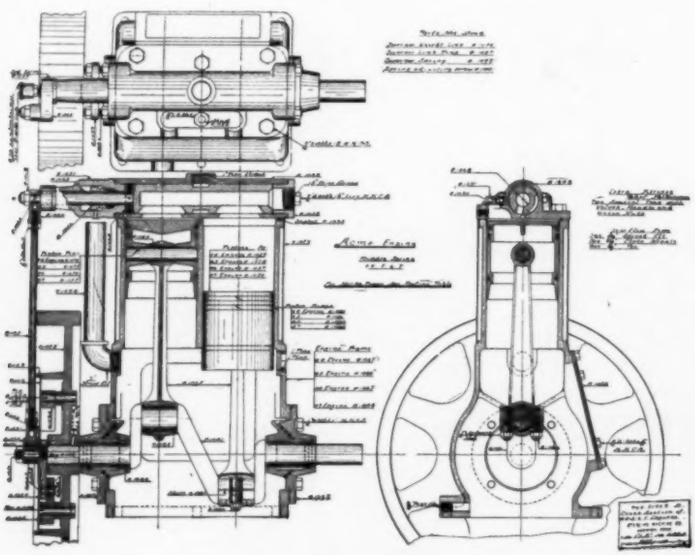


DIAGRAM OF ENGINE.

Chicago Telephone Employees Hold Picnic.

Employees of District 41, plant department of the American Telephone & Telegraph Company, held their first annual picnic August 20 at Dellwood Park, Ill. The event was most enjoyable, being favored by ideal weather and large crowd. The athletic program featured strongly in holding the participants in a tenor of excitement and enthusiasm for the day. Special cars were provided for transportation from Archer limits to Dellwood Park and the ride was most pleasant.

Current Electrical News

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

The request of the New York Edison Company for a rehearing by the Public Service Commission in the case of its authorization of a bond issue of $50,000,000 by the Long Acre Electric Light & Power Company, of New York City, was refused by the Commission last week. This is supposed to remove the last obstacle in the way of the Long Acre Company going ahead under its comprehensive franchises to supply current on Manhattan Island for light and power. The Edison Company has announced its intention to take the question, however, to the courts, basing its opposition on the argument that another light company is not needed.

The Long Acre Company is the owner of valuable franchises that have stood the tests of strong opposition and is today backed by able men and an abundance of foreign and American capital. Its new directors will be announced in a few days and plans for early and extensive service are being rapidly perfected.

IMPORTANT DEVELOPMENTS.

(Special Correspondence.)

CALIFORNIA DEVELOPMENTS.—Officials of the Great Western Power Company state that the dam at Oroville will be completed by January, 1913, and that work will then start on the erection of three additional power plants representing a total investment of $15,000,000. The additional plants will be located on the north fork of the Feather River at Butte Creek, Mosquito Creek and Bartlett's Bar. All will have approximately the same capacity as the present plant at Las Plumas, making a total approximate production of 500,000 horsepower. The four plants of the Great Western Power Company will be strung along the river for a distance of fifty miles.

A WASHINGTON PROJECT.—The Pacific Power & Light Company, of Spokane, plans to develop 1,000,000 horsepower by its hydroelectric installation in the Columbia River at Priest Rapids, Wash., southwest of Spokane, at a cost of from $8,000,000 to $10,000,000. It is estimated that eight years will be required to complete the work. The project includes the construction of an enormous dam across the river at the foot of the rapids, the face of the wall to be seventy-five feet in height, or equal to the drop of the stream in a distance of nine miles; the building of the high-line canal of the Hanford irrigation plant, and the stringing of a network of transmission lines to supply power and light to a large part of eastern Washington. A wing dam, diverting part of the current of the Columbia River from the main channel into a power canal, is now furnishing power for the company's electric plant at Priest Rapids, and the use of this method of development will be continued until the large dam is in position.

LIGHTING AND POWER.

(Special Correspondence.)

KELLY, N. M.—The Germany mine will build an electric light and power plant. A.

TENAHA, TEX.—C. C. Swindell has been granted an electric light franchise here.

BAKER, ORE.—The Eagle River Electric Power Company is building a new power plant. A.

WINTERS, CAL.—The Pacific Gas & Electric Company will reconstruct its entire system here. A.

CONCONULLY, WASH.—The electric light plant here was recently completed and is now in operation.

PAWHUSKA, OKLA.—This city has voted bonds for $10,000 to extend and improve the electric light plant.

KIRKWOOD, MO.—This city is about to vote a $10,000 bond issue for electric light and water improvements.

MUSCODA, WIS.—Muscoda has voted bonds for $5,000 for enlarging and repairing the electric light plant.

PALMS, CAL.—By a vote of fifty-nine to four this town has voted to install an electric street-lighting system. A.

CLARKSVILLE, ARK.—This city will soon vote on a proposition to issue light bonds to the amount of $75,000.

MASCOUTAH, ILL.—At a special election the proposition to raise $12,000 for a city lighting plant was carried.

MINNEOTA, MINN.—J. H. Jonathan has been granted a franchise to install an electric light plant.

BROWNS VALLEY, MINN.—Bonds for $10,000 for the construction of an electric light plant have been voted.

MISSOULA, MONT.—The Missoula Light & Power Company is considering the installation of a lighting system to cost $10,000.

GRANTS PASS, ORE.—The Golden Drift Dam Company will install a large hydroelectric plant on the Rogue River. A.

METROPOLIS, NEV.—The Pacific Reclamation Company, Salt Lake, Utah, will install an electric lighting system here. A.

ELKHART, IND.—The City Council has passed an ordinance providing for underground wiring throughout the entire business district. S.

BROWNS VALLEY, MINN.—At a special election held recently, bonds were voted in the sum of $10,000 for an electric light plant.

SALT LAKE, UTAH.—Plans have been made for the construction of a hydroelectric power plant at Riverdale, near Ogden, Utah.

LEWISTON, IDAHO.—The Nezperce Power & Light Company is making preparations to put a transmission line through the Lewiston district.

CHEHALIS, WASH.—The Washington-Oregon Corporation has completed its new power plant here, and placed it in service. The plant cost $75,000. A.

VENICE, CAL.—An isolated power plant will be erected in connection with the new Polytechnic High School. N. F. Marsh, of Los Angeles, is the architect. A.

TOWER, MINN.—Bonds for $18,000 have been voted for the construction of a hydroelectric plant, and this will probably be installed in a short time.

WAKARUSA, IND.—The Home Electric Company has been incorporated with a capital stock of $15,000 by James E. Gall, J. E. Brelenbacher and others.

TOPEKA, KANS.—A number of improvements have been made in the local street-lighting system. New arc lights and a new transformer have been installed.

PAXTON, ILL.—Paxton is to construct a $17,000 electric light plant, having authorized the issuance of bonds for its construction and the purchase of machinery.

POCAHONTAS, IOWA.—At an election held here to decide on an $11,000 bond issue for the purpose of building a municipal electric plant, the proposition was carried.

ANNISTON, ALA.—An effort is being made by Blue Mountain City, a mill town close to Anniston, to secure electric lights. The mayor is at the head of the movement.

SAN JOSE, CAL.—The Great Western Power Company has made application for a fifty-year franchise for a power system covering the entire county of Santa Clara.

SALT LAKE CITY, UTAH.—An electric light and power plant will be installed in the new department store to be erected by F. Auerbach & Brothers on Third Street. A.

LOGANSPORT, IND.—The lighting plant here was recently badly damaged by lightning. Generators and switchboards were burned out, leaving the town in darkness.

DETROIT, MICH.—The Consolidated Light & Power Company, capitalized at $100,000, has been incorporated by J. L. Hudson, F. R. Poss and C. S. Abbott, all of Detroit.

PHILADELPHIA, PA.—The Moberly Light & Power Company has been incorporated with a capital of $300,000 to generate and supply electricity for light, heat and power.

ELY, NEV.—The Telluride Power Company, of Colorado, will build a 3,000-horsepower plant on Cleve Creek, near this city. Light and power will be furnished the mining camps. A.

SACRAMENTO, CAL.—The Retail Merchants' Association will install an electrolier lighting system in the business section. The city will take over the system when completed . A.

STANTON, MICH.—The proposition to bond the city for $10,000 to build a municipal electric lighting and water works plant was carried at a special election by a large majority.

COLUMBIANA, ALA.—The Dixie Sanitorium, Land & Investment Company, which acquired the franchise for a lighting plant, will construct a combination electric and ice plant.

DEER RIVER, MINN.—The Everton Light & Power Company will erect a large electric light plant here. Work commenced a short time ago and will be pushed to completion.

METALINE FALLS, WASH.—The Metaline Falls Light & Water Company was recently incorporated with a capital of $50,000 by Lewis P. Larsen, Jens Jensen and H. W. Reading.

AUSTIN, TEX.—The Bryan Power Company, of Bryan, has been chartered with a capital stock of $70,000. The incorporators are J. L. Lawler, H. T. Lawler and H. T. Lawler, Jr.

CHICO, Cal.—The Northern Electric Company has acquired a

franchise, in the name of G. E. Springer, on Ninth, Oak and Fifth streets. Construction on this line will soon commence. A.

MESKILL, WASH.—The State will install an electric light plant in connection with its new rock-crushing plant here. P. E. Robins, state superintendent of quarries, has the matter in charge. A.

LOS ANGELES, CAL.—The Southern California Edison Company has been awarded the contract for lighting the Hawthorn District of this city. The poles and wires will be put up at once.

LOUISVILLE, KY.—The 10,000-kilowatt turbine of the Louisville Lighting Company was put in operation on August 13. The capacity of the plant is more than doubled by this recent addition.

CORONA, CAL.—The Southern Sierra Power Company of Riverside, has purchased the plant of the Corona Gas & Electric Company. Lower rates for lighting, it is said, will be established very soon. A.

ELEPHANT BUTTE, NEW MEX.—W. E. Anderson, El Paso, Tex., has been awarded a contract for machinery and electrical equipment for the power house used in connection with constructing the dam here. A.

SYRACUSE, N. Y.—Several hundred acres of land in Redfield, Oswego County, have been sold to the Niagara Power Company. This land is to be used in connection with the development of power at Salmon Falls.

TOWER, MINN.—At an election held recently the proposition to bond the city for $18,000 carried by a good majority, to build a hydroelectric plant at Pike River Falls to furnish electric light and power to this city.

INDIANAPOLIS, IND.—The County Commissioners propose to abandon the county heating and lighting plant and are advertising for heat and current to heat and light the jail, court house and other county buildings. S.

MEDFORD, ORE.—The residents of Griffin Creek have voted unanimously for the installation of a power line along Griffin Creek. This will supply light and power to the county rock quarry and to about forty farms.

FRESNO, CAL.—The Pacific Light & Power Corporation of Los Angeles has filed articles of incorporation here, with capitalization of $40,000,000, in connection with its proposed power plans for development on Big Creek. A.

GARY, IND.—The Board of Public Works has granted a twenty-five-year franchise to T. B. Dean, of Chicago, for the construction and operation of a central heating plant that will supply both business houses and residences with heat.

WINONA, MINN.—The Winona Railway & Light Company, a subsidiary of the La Crosse Water Power Company, has been placed in the hands of a receiver. Howard Morris, of Milwaukee, Wis., was appointed receiver under bonds of $50,000.

SACRAMENTO, CAL.—The North Sacramento Light & Power Company has been incorporated with a capital stock of $50,000 to operate in the Haggin Grant district. R. C. Waring, Marshall Diggs and M. N. Williamson are the incorporators. A.

KALMATH FALLS, ORE.—The Siskiyou Electric Light & Power Company has awarded a contract to O. W. Sly, Dorris, Cal., for supplying poles for its new line between this city and Dorris. Construction on this transmission will commence at once. A.

RUTLAND, VT.—The Rutland Railway, Light & Power Company has begun work on a large dam on Mill River. The dam will be built of reinforced concrete and will impound water under sufficient head for the generation of 1,000 horsepower.

SIOUX FALLS, S. D.—The Bennett Electric Light & Power Company has closed a deal whereby its interests have been transferred to Frank Thompson and associates of St. Paul. The Thompson syndicate paid $80,000 for the company's interests.

SPOKANE, WASH.—The International Power & Manufacturing Company has been incorporated with a capital stock of $250,000 by Wilber Yearsly and Marton H. Gerry, Jr. A dam is to be built across the river and a power plant erected at Millwood.

LOS ANGELES, CAL.—The Pacific Light & Power Company, of Los Angeles, has been incorporated by H. E. Huntington, W. G. Kerckhoff, K. Cohn, G. S. Ritton, Chas. Forman, A. M. Kemp and Howard Huntington, with a capital stock of $40,000,000.

BILLINGS, MONT.—Work has been started on the construction of the car line at Fourth Avenue North and North Twenty-eighth Street. The Council has enlarged the decorative lighting in the business district and will install 118 additional light posts. C.

LOS ANGELES, CAL.—The City Council has voted $10,500 from the general expense fund for use in making plans and surveys for the power plants and transmission line along the aqueduct. Additional power sites, other than proposed in initial report, will be filed upon.

TRINIDAD, COLO.—The Colorado Light & Power Company's holdings have been sold at a receiver's sale to the Federal Traction Company of New York for $950,000. They were bid in by C. C. Chapelle of New York who announced that large extensions would be begun at once.

LONG BEACH, CAL.—The power plant of the Southern California Edison Company, with an initial capacity of 15,000 horsepower, has been completed and will be placed in operation at once. This plant, to date, has cost approximately $2,000,000. It is built on the unit plan to provide for additions. A.

EL CAJON, CAL.—Power is now received in this city from the new line of the San Diego Consolidated Gas & Electric Company, which has just been constructed through El Cajon valley from La Mesa to Lakeside. Many residences and stores are supplied with power for lighting.

DETROIT, MICH.—Authority to organize has been granted to the Consolidated Light & Power Company by the State Railroad Commission. The stockholders in the company are J. L. Hudson, president; vice-president and general manager, Charles S. Abbott; secretary-treasurer, Robert Tannehill and F. R. Poss.

SAN BERNARDINO, CAL.—The California-Nevada Power Company has awarded contracts to Milliken Brothers, New York City, for 2,000 steel towers, and to the Aluminum Company of America for 1,175 tons of wire, for use in constructing its transmission line from Bishop to this city, a distance of 240 miles. A.

GORDON, NEB.—Contracts were let recently to the Katz Craig Construction Company, the Johnson Electric Company and the Sunderland Machinery and Supply Company of Omaha, for the construction of water and light plants and the installation of a sewage system. Bonds were sold to the amount of $25,000.

MANHEIM, PA.—The Manheim Electric Light Company, which lights the boroughs of Manheim and Mount Joy, has been purchased by the Susquehanna Railway and will be operated by that company. Almost the entire amount of $50,000 in stocks and $50,000 in bonds was held by C. S. Stover of Philadelphia.

MOUNT VERNON, WASH.—The Stone & Webster Company has purchased the plant of the Mount Vernon Light & Power Company at a price said to be $26,000. The plant will be augmented, and a local substation to serve the Bellingham-Mount Vernon Interurban Railway erected. Robert Bowels will be local manager.

FAIRMOUNT, W. VA.—A charter has been issued to the Preston County Development Company of Cascade, which will furnish light and power to Masontown, Morgantown and Kingswood. Capital stock is $100,000. The incorporators are Everhart Breirer of Morgantown, C. C. Clear, and A. W. Hawley of Masontown, Roy Clear and D. D. Davis of Cascade.

BINGHAMPTON, N. Y.—At a meeting of the Board of Contract and Supply a contract was awarded to the Binghampton Light, Heat & Power Company to supply the city with flaming arc lights in the business portion, a number of enclosed arc lamps of a type similar to those now in use on the main thoroughfares and about 1,200 Tungsten incandescent lights for side streets.

GALLIPOLIS, O.—The Gallipolis Gas & Coke Company, which controls the electric lighting system in this city, has gone into the hands of a receiver. R. P. Aleshire, of Huntington, W. Va., acting as trustee for the bondholders, brought the suit. The claim is made that the company has defaulted in the payment of interest on $30,000 bonds issue several years ago when the company took over the electric lighting plant. H.

RUTLAND, VT.—Rice Brothers, of Granville, N. Y., have contracted with the Rutland Railway Light & Power Company for a supply of power for their quarry near Rutland. The electrical equipment will consist of a seventy-five-horsepower motor with the necessary auxiliaries. The Rutland Railway Light & Power Company also will install a fifteen-horsepower motor in a mill now being built by the Old English Slate Company in the Scotch Hill district north of Fair Haven, and an eighteen-horsepower motor for a hoist in the Hampton Slate quarry plant about a mile south of Carvers Falls.

SIOUX FALLS, S. D.—H. M. Byllesby & Company, engineers and managers of public utilities, have purchased the property of the Sioux Falls Light & Power Company of Sioux Falls, South Dakota. This company owns and operates a waterpower plant on the Big Sioux River, reinforced by a modern steam auxiliary station, and serves the greater part of Sioux Falls with current for lighting, transportation and power. Formal possession will be taken in a short time with N. C. Draper, formerly of Zanesville, O., as manager. Improvements and extensions will be made to the property.

DEFIANCE, O.—James M. Ashley, of Toledo, president of the Auglaize Power Company, announces that his company has secured a renewal of its contract with the state for the use of water power from the Grand and Lorimer reservoirs, for a period of twenty-five years, for a rental of $4,000 per year. In addition the company has filed a $25,000 bond to protect the state against loss by overflow. About $100,000 will be expended creating facilities for the collection, storage and transportation of water for use in dry weather. The company is now building an immense power plant and dam near this city to generate electrical power. H.

FORT WORTH, TEX.—The Fort Worth Light & Power Company has been incorporated at Austin, with a capital stock of $3,560,000. The concern will take over all the properties of the J. R. Nutt Company, it is stated, including the electric plants, dam, franchises, etc. Application for the charter was filed by W. A. Hanger. It authorizes the company to supply power for light and heat for fifty years. The directors of the new company are: J. R. Nutt, Cleveland, O.; George T. Reynolds, T. R. Yarbrough, W. C. Stripling, John P. King and A. J. Duncan, Forth Worth.; Geo. Holbrook, J. H. Miller and D. W. Myers, Cleveland, O.

ELECTRIC RAILWAYS.

(Special Correspondence.)

REDLANDS, CAL.—The Pacific Electric Railway contemplates the construction of a line from this city to Highland. A.

SAN FRANCISCO, CAL.—The Napa and Clear Lake Railway has beeen incorporated for $500,000 by C. W. Conlink, W. R. Rank and R. A. Morton.

SAN FRANCISCO, CAL.—The Board of Public Works will have forty-three P-A-Y-E steel cars, constructed by contract for the Geary Street municipal railway. A.

SALT LAKE, UTAH.—The Utah Light & Railway Company has made application for a franchise for a street car line on Fifteenth Street and North State Street in this city.

PHOENIX, ARIZ.—The Salt River Valley Electric Company has applied for a franchise for an electric railway through certain streets of Phœnix for a period of twenty-five years.

SEBASTOPOL, CAL.—The Petaluma & Santa Rosa Railway Company has been granted a fifty-year franchise for a standard-gauge electric railroad along all streets in Sebastopol.

SAN DIEGO, CAL.—The bid of the San Diego Electric Railway Company of $60,000 for a forty-two-year franchise over all of its lines in this city has been accepted by unanimous vote of the Council.

SAN JOSE, CAL.—The San Jose Railroads have made application for a fifty-year franchise for a double or single-track standard-gauge electric railway along Willows Street, Delmas and Lincoln Avenues, San Jose, Cal.

WOODLAND, CAL.—The preliminary surveys of the West Side Electric Railroad lines between Red Bluff and Woodland will be started at once, and Engineer Dozier expects to give his report to the executive committee within five months.

TEXARKANA, TEX.—The Texarkana Electric Railway Company is double-tracking its line from Hazel Street west to Elm Street, a distance of about half a mile. The company will make other important improvements to its property. D.

ATTICA, IND.—The citizens of this city and community are working hard to secure the Kokomo, Frankfort & Western Traction line which rumor says will be extended from Frankfort to Danville, Illinois, to connect with the McKinley System. S.

HIBBING, MINN.—The Mesaba Railway Company will shortly let the contract for grading, etc., of its interurban line to connect the range towns. The cost of construction and equipment is estimated at $1,200,000. E. C. Thomas is engineer in charge. C.

VINCENNES, IND.—The Vincennes Southeastern Interurban Railway Company is planning to build a new interurban station in this city. The company, which is building a traction line from Vincennes to St. Meinrod, in Spencer County, will also locate the machine shops in Vincennes, with car barns in Petersburg. S.

NORTH BEND, ORE.—The City Council has revoked the electric-railway franchise held by the defunct Coos Bad Rapid Transit Company. A franchise will be granted to the C. A. Smith Company, which was awarded a franchise at Marshfield, and which plans for the construction of a line between the two cities. A.

TOMBSTONE, ARIZ.—F. M. Winters, Jacob Kleck, W. S. Furiss, Dr. J. M. Sweetman and C. C. Lewis are the incorporators of an electric railway line connecting Tombstone, Hotel in the Rock, Glendale, Pebria and other nearby points. The company has a capital stock of $600,000 and will begin construction work at once.

LOS ANGELES, CAL.—The construction of a broad-guage road from Homewood to Watts, for the Redondo line of the Pacific Electric Company, is to begin at an early date. When this is completed the entire line from Homewood to Redondo will be changed into a broad-gauge road, so that cars can be operated through to Los Angeles.

OKLAHOMA CITY, OKLA.—The Oklahoma Shawnee Railway Company has filed amended article of incorporation changing its name from Oklahoma-Shawnee Interurban Railway Company. The capital stock is $3,000,000 and the incorporators are H. A. Kroeger, Carlos Combs, M. E. Springer, A. R. Betlic and A. Cook, all of Oklahoma City.

DALLAS, TEX.—The Dallas Southern Traction Company has filed its charter in the Secretary of State's office in Austin and has a capital of $2,000,000. Its purpose is to construct, maintain and operate an interuban electric line between Dallas, Waxahachie and Ennis. The incorporators are Edwin B. Parker, J. H. Tallichet and David Daley, all of Houston. D.

SACRAMENTO, CAL.—A traffic agreement has been made bebetween the Santa Fe Railroad and the electric roads communicating with the Sacramento Valley towns. The principal points benefitted are Lodi, Sacramento, Marysville, Yuba City, Gridley, Oroville and Chico. Woodland will shortly be benefited by the completion of the Sacramento-Woodland line now under construction.

MOROCCO, IND.—The Indiana & Northwestern Traction Company which is planning to build south from Chicago through Newton, Benton and Tippecanoe counties, has changed its original route so as to cut out Rensselear and touch Kentland instead. The Lawler brothers of Chicago own a large body of land in Newton County, will give the right of way through this land and also contribute largely toward the construction of the road. S.

VINCENNES, IND.—Of the subway elections held in three towns ships in Knox county, August 11, in aid of the construction of the Vincennes North and South Traction Company's road, one was carried and two defeated. A similar election held in Sullivan County for the same purpose was likewise defeated. When this road is completed between Vincennes and Sullivan there will be continuous traction service between Indianapolis and Evansville. S.

INDIANAPOLIS, IND.—The Indianapolis Traction & Terminal Company is pushing the work on its mammoth power house with a view of putting it in operation for State Fair week, September 4. One big turbine generator has been installed in the new plant. This will produce almost unlimited power. This immense power plant is designed to furnish power for all the city cars and two divisions of the Terre Haute, Indianapolis & Eastern Traction system. S.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

DELL RAPIDS, S. D.—The long-distance telephone line through Dell Rapids is being rebuilt. C.

MARINETTE, WIS.—The Harmony Telephone Company has been incorporated with a capital stock of $10,000.

PASCO, WASH.—The Twin City Telephone Company will erect a new exchange plant here to cost about $30,000.

HIBBING, MINN.—It is probable that the telephone trunk line to Alice and Brooklyn will be increased in the near future. C.

KALAMA, WASH.—The Cowlitz Bend Telephone Company has been granted a franchise by the Board of County Commissioners of this county. A.

GIBSON CITY, ILL.—The Gibson Home Telephone Company will rebuild its lines, the improvement calling for 12,000 feet of new cable. Z.

SPEARFISH, S. D.—The Nebraska Telephone Company is planning to remodel its telephone service and will install an exchange in the Mathews Building. C.

PESHTIGO, WIS.—Work has been started on the construction of two trunk lines for the Harmony telephone system from Harmony Corners to Marinette. C.

PINEVILLE, ORE.—The Oregon Central Telephone Company has been incorporated with a capital stock of $50,000, by Louis Doonar, C. R. Cook and N. W. Sanborn.

JOSEPH, ORE.—The Wallowa County forest reserve, of which J. F. McClain is superintendent, will build a telephone line to the Rangers camp, a distance of fifteen miles. A.

BIG HORN, MONT.—The Big Horn Telephone Company, capital $20,000, of which Charles Lee is secretary and treasurer, has been organized to construct a line to Custer, Mont. C.

ROCHESTER, MINN.—The Rochester Telephone Company has applied to the Council for a new franchise with a view of installing improvements at a cost of several thousand dollars. C.

LOS ANGELES, CAL.—In the city budget for operating expenses, 1911-12, adopted by the City Council, an appropriation of $92,855 is made for a modern fire and police telegraph system. A.

FORMAN, N. D.—John Powers, Havana; A. E. Land, O. H. Gardner and E. M. Fijelstad, Forman, have incorporated the Farmers' Rugland & Havana Telephone Company. The capital stock is $10,000. C.

LOS ANGELES, CAL.—The Pacific Telephone & Telegraph Company has made plans for the erection of new exchanges in the Moneta and Garvanza districts. A new station will also be erected at Long Beach. A.

LINTON, IND.—The Vicksburg Mutual Telephone Company, recently incorporated to build and operate a telephone system in Greene County, is in the market for material and equipment. O. D. Clayton is president. S.

KALAMAZOO, MICH.—The Independent Automatic Telephone Company has been laying conduits in this city. It is said that within another year there will be a new telephone company doing business in this city.

HARRISBURG, PA.—The Farmers' Interurban Telephone Company, of Westmoreland County, was recently incorporated. It will establish a line connecting Irwin, Adamsburg, Arona and other towns. The company is capitalized at $5,000.

COWEN, O.—The Cowen Telephone Company, of Cowen, has been incorporated to construct and operate a telephone line. The capital stock is $5,000. The incorporators are J. J. Hartley, J. C Kessler, B. F. Miller, A. G. Johnson and D. C. Hoover, of Cowen.

MARSHALLTOWN, IOWA.—The Merchants', Mechanics' & Farmers' Telephone Company has been organized and will let a contract in September for the construction of a modern exchange and the installation of a system.

SAN ANGELO, TEXAS.—The San Angelo Telephone Company has started work on the laying of 20,000 feet of conduits under Chadbourne Street, the main street of the city, which is to be paved shortly. The underground system will supply 12,000 phones. D.

KELSO, WASH.—The Coweeman Telephone Company will extend its lines into the Shanghi valley. The poles are now on the ground and construction work will begin at once.

BURTON, TEXAS.—The Burton Telephone Telephone Company is installing a telephone system with central office and switchboard here in order to give the rural lines connection with other lines entering Burton. Night service will also be installed. D.

ELECTRICAL SECURITIES.

A special stockholders' meeting of the Pacific Light & Power Corporation has been called for October 9, for acting upon the question of increasing the bonded indebtedness, now $3,000,000; to $38,000,000. The issue will be 35,000 bonds of the par value of $1,000 each, five-year, bearing six per cent.

As a sequence of the decision to retire $18,000,000 first mortgage bonds of the Northwestern Elevated Railroad of Chicago upon their maturity, Sept. 1, the trustees of the company have authorized a new first mortgage of $25,000,000. This mortgage must be held as part of the collateral security of the Chicago Elevated Railways issue of $30,000,000 of five-per-cent three-year notes.

A circular is being mailed to the Hudson River Power Company's bondholders announcing that a reorganization plan recently outlined to them by the protective committee headed by James R. Hooper, of Boston, has become operative through the approval by more than fifty-one per cent of the security holders concerned. This means an actual written consent to the plan has been received from considerably more than $5,000,000 of the outstanding bond issues of the eight Hudson River companies involved.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.

	Aug. 21.	Aug. 14.
Allis-Chalmers common	6¾	6¾
Allis-Chalmers preferred	21	21
Amalgamated Copper	62	61½
American Tel. & Cable	78⅜	78⅜
American Tel. & Tel	134	134
Brooklyn Rapid Transit	76¼	74¾
General Electric	154¾	154¾
Interborough-Metropolitan common	15¼	16
Interborough-Metropolitan preferred	43½	42¾
Kings County Electric	129	129
Mackay Companies (Postal Telegraph and Cables) common	83½	83½
Mackay Companies (Postal Telegraph and Cables) preferred	74	74
Manhattan Elevated	135	135
Metropolitan Street Railway	18	18
New York & New Jersey Telephone	103	103
Pacific Tel. & Tel	40	38⅛
U. S. Steel common	73¾	72⅝
U. S. Steel preferred	115⅝	115⅝
Western Union	75½	73½
Westinghouse common	66½	65⅝
Westinghouse preferred	118¼	118¼

*Last price quoted.

BOSTON.

	Aug. 21.	Aug. 14.
American Tel. & Tel	134	134
Edison Electric Illuminating	287	287
General Electric	154⅜	152
Massachusetts Electric common	20	20
Massachusetts Electric preferred	90¼	90¼
New England Telephone	149	149
Western Tel. & Tel. common	19	19
Western Tel. & Tel. preferred	96½	96½

PHILADELPHIA.

	Aug. 21.	Aug. 14.
American Railways	44½	44½
Electric Company of America	11⅞	10⅞
Electric Storage Battery common	53½	52
Electric Storage Battery preferred	55	55
Philadelphia Electric	17¼	17½
Philadelphia Rapid Transit	23	22⅝
Philadelphia Traction	86½	86½
Union Traction	51¼	50½

CHICAGO.

	Aug. 21.	Aug. 14.
Chicago Elevated common	25	25
Chicago Elevated preferred	88	90
Chicago Railways, Series 1	95	95
Chicago Railways, Series 2	29¾	29½
Chicago Subway	2⅞	2¾
Chicago Telephone	123	123
Commonwealth Edison	134	131
National Carbon common	100	111
National Carbon preferred	117	117

PERSONAL MENTION.

F. A. SMOOT has been appointed district manager of the Mountain States Telephone & Telegraph Company at Provo, Utah.

N. B. AYERS recently resigned his position as chief engineer of the Dayton Power & Light Company, of Dayton, Ohio, to organize the Ayers Engineering Company for handling power-plant engineering.

E. BURTON SMITH, formerly with the Harrison, N. J., branch of the General Electric Company, has been appointed superintendent of the Toledo Lamp Works of the General Electric Company, at Toledo, Ohio.

TRACY LYON, formerly with the Westinghouse Electric & Manufacturing Company in the capacity of assistant to the first vice-president, is now connected with the General Motors Company, of Detroit, Mich.

J. E. POWELL, of Washington, D. C., has resigned his position of chief mechanical and electrical engineer in the office of the supervising architect, Treasury Department. Mr. Powell's resignation was due to ill health.

C. P. LINDSLEY, president of the Lindsley Brothers Company, Spokane, Wash., is making an extended inspection trip to the company's pole yards which are located in Northern Idaho, Northeastern Washington, and in British Columbia, at Nakusp on Arrow Lake.

VICTOR R. DESPARD, who has been traveling the country wide for Pass & Seymour Company, Solvay, N. Y., will take charge of the company's Chicago office. Mr. Despard has made many friends and he will prove a strong factor in the Company's western organization. He will make his home in Chicago after the first of October.

GEORGE V. W. INGHAM, for the past five years associated with Pass & Seymour Company, Solvay, N. Y., has left the position of manager of this company's Chicago office to become associated with the Chicago office of the Bryant and Perkins companies. Mr. Ingham has been a very successful salesman and manager; he has a wide acquaintance throughout the field; is highly popular, and a host of friends and acquaintances will wish him success in his new occupation.

GANO DUNN, who for some years has been first vice-president, chief engineer and a director of the Crocker-Wheeler Company, has resigned from that company in order to accept an important engineering and executive position. Mr. Dunn will sail shortly for Europe to attend, as president of the American Institute of Electrical Engineers, the meeting, during the Turin Exposition, of the International Electrotechnical Commission, to be held on September 7, 8 and 9, as well as the succeeding sessions of the International Electrical Congress.

OBITUARY.

M. ERNEST MERCADIER, formerly director of l'Ecole Polytechnique, of Paris, died on July 27. M. Mercadier was well known in electrical circles abroad, having been Director of Telegraphs during the siege of Paris, at which time he organized the military telegraph service. After the war he became professor of physics at l'Ecole Supérieure de Telégraphie, and in 1891 was made director of studies at l'Ecole Polytechnique, where he remained until 1903. M. Mercadier was a member of a number of foreign engineering socities and was the author of a number of technical works.

DR. ISAAC ADAMS, well known for his work in electro-chemistry, and his inventive ingenuity, died on July 24 at the age of seventy-five years. Dr. Adams was born in Boston and was of old Colonial stock, his father being Isaac Adams, inventor of the Adams printing press. He received his preparatory school education in Chauncey Hall school and entered Bowdoin College, graduating with honors in 1858. He then entered the Harvard medical school, and after his graduation from that institution went abroad for a post-graduate course in the School of Medicine in France. He early became interested in electro-chemistry and the inventive ingenuity of the family markedly manifested itself. He invented the method of nickel plating and, unlike the average inventor, combined the business with the creative faculty, and pushed his inventions to a high degree of success. He became president of the United Nickel Plating Companies in Boston and New York, and traveled extensively abroad in the interest of his companies, establishing branches in the principal European countries.

NEW PUBLICATIONS.

FRANCHISES OF ELECTRIC CORPORATIONS IN GREATER NEW YORK.—This report, prepared by Commissioner Milo R. Maltbie, deals with the conditions and franchises of companies operating in New York City. The records obtained are classified, and a careful analysis made of existing conditions.

THE STRENGTH OF FLAT PLATES.—The question of the stresses in flat plates such as are used in tanks, bins, etc., is taken up at length, and numerous formulae derived. Results of the investigations are given in the form of curves. The paper, of which the bulletin is a reprint, was prepared by T. A. Bryson, of the class of 1910, Rensselaer Polytechnic Institute.

ELECTROLYSIS OF WATER PIPES IN CHICAGO.—The Chicago Bureau of Public Efficiency has just published a bulletin in which the question of electrolytic damage to water pipes, as found in the City of Chicago, is quite thoroughly dealt with. The statement is made that about two-thirds of the water pumped by the city is lost, and a large part of this loss is attributed to leaky water pipes, a condition brought about by electrolysis. A number of photographs have been reproduced to show the manner in which the pipes are affected and a considerable amount of interesting data is given. A folding map of the city indicates the places where stray current was found to be leaving the water pipe.

MINERAL RESOURCES OF THE UNITED STATES, 1909.—The United States Geological Survey has published in two volumes its annual report on the "Mineral Resources of the United States for 1909." Part I, consisting of 617 pages, gives the data and comments on the production of metals. Part II, with its 942 pages, is devoted to the production of the non-metals. This is the twenty-sixth annual report on the country's mineral resources and this year is perhaps more complete than usual because in the compilation of the data assistance was afforded by the Bureau of the

Census. This co-operation, however, resulted in some delay in the complete publication of the report. Advance chapters therefrom on copper, coal, etc., have been abstracted in these columns in earlier issues.

FOREIGN TRADE OPPORTUNITIES.

(From Daily Consular and Trade Reports, issued by the Bureau of Manufacturers, Washington, D. C. In replying to the Bureau for information mention file number.)

NO. 7181. ELECTRICAL MACHINERY.—An American consul in Asia forwards the name of a person in his district who wishes prices f. o. b. Seattle, Wash., with the gross and net shipping weights, on the following electrical machinery: 250-kilowatt sixty-cycle alternating-current, three-phase, 2,000-volt generator; 100-horsepower sixty cycle alternating-current, three-phase, 1,000-volt motor; seventy-five-horsepower sixty-cycle alternating-current, three-phase, 1,000-volt motor; 250-kilowatt air-cooled step-up transformer, 2,000 to 10,000 volts; 250-kilowatt air-cooled step-down transformer, 10,000 to 1,000 volts; ten-kilowatt air-cooled step-down transformer, 1,000 to 110 volts; twenty-kilowatt air-cooled step-down transformer, 1,000 to 110 volts; 350-horsepower turbine to work under 50-foot head; ten-inch centrifugal pump, for raising water, sand, and fine gravel to a height of forty feet; pump to be lined with manganese steel and liners easily replaced; six-inch centrifugal pump, three-stage, for raising water to height of 200 feet. Instruments, switchboard, governors, wire, etc., will also be required. Prices on wire should be quoted per pound on aluminum and copper, as the customs duty of eastern Siberia is high on all kinds of wire and is assessed according to weight, and as aluminum is considerably lighter it might prove more profitable to use it in place of copper.

NO. 7186. ELECTRIC-LIGHT FIXTURES.—A firm in Germany informs an American consular officer that it wishes to be put in communication with firms in the United States manufacturing brass electric-light fixtures, especially those producing the small brass screw caps for holding the ordinary electric bulbs.

NEW INCORPORATIONS.

NEW YORK, N. Y.—The Salom Battery Company has been incorporated with a capital of $10,000 by J. Hibberd Taylor, John S. Clement, Samuel D. Heed and Edward D. Palmer. The company will manufacture electric batteries.

NEW YORK, N. Y.—The Buyer Electrical & Supply Company was recently incorporated by Maurice Hogler, Richard Buyer, Louis Goldin and Fred Kuehne. The capital is $5,000 and the company's purpose is to do general electrical work.

ALBANY, N. Y.—The Davies Electric Company has been incorporated with a capital of $5,000 by Ernest Rieck, William P. Davies, William T. Poole and Richard E. Ellis, all of Albany. The company will do electrical contracting work, etc.

LEGAL NOTES.

JUDICIAL NOTICE TAKEN THAT WIRES ARE DANGEROUS.—The Supreme Court of Michigan says that it may take judicial notice that it is a matter of general knowledge that electric wires of high voltage, even if insulated, are dangerous, and to be avoided.—Sweezo vs. Cheboygan Electric Light & Power Company, 131 N. W. 125.

NOT INTERSTATE COMMERCE.—The Supreme Court of Michigan holds that where a contract was made by a corporation of another state for the sale of lamps which contemplated the maintenance, within the State of Michigan, of an agency for the purpose of examining, repairing and replacing the goods sold for an indefinite period of time, and such an agency was maintained, so that it was not the case of a single transaction, within the state, accompanying or merely incidental to the business of selling goods and installing or setting them up for use, but was the case of conducting, within the state, a regular and continuous business in aid and furtherance of the general business of the company, the business so carried on, within the state, was not interstate in nature.—Nernst Lamp Company vs. Conrad, 131 N.

CALL TICKETS ADMISSIBLE IN EVIDENCE.—The Court of Civil Appeals of Texas holds, in a suit brought to recover damages for an alleged negligent failure to furnish a requested long-distance telephone connection, that the original call tickets kept by the defendant's operators on the night in question were admissible in evidence in the case, as a proper record containing the original necessary entries made by the defendant's employees in properly carrying on its business. The court says that it sees no reason why the record of original entries of this kind should not be admissible in evidence just as the books of original entries of a merchant are admissible. Moreover when such records are shown to have been properly kept and are properly identified, the court thinks that the entries therein would be admissible unaccompanied by the testimony of the operator who made them.—Southwestern Telephone & Telegraph Company vs. Pearson, 137 S. W. 733.

PRESUMPTION THAT WIRES ARE NOT INSULATED.—The Supreme Court of Appeals of West Virginia holds that if a person, at a place where he has a right to be, is injured by contact with an electric light wire, there is a prima facie presumption that the wire was not properly insulated, which presumption, unless rebutted, will establish negligence in the owner of the wire in failing to have a properly insulated wire. An electric light company is bound to use a high degree of care to keep its wires safely insulated at places where persons may be lawfully in close proximity to them, and accidentally come in contact with them. For example, workmen have a right to be on any part of an iron bridge in necessary work in painting it, and an electric light company having its wires on the bridge must keep them properly insulated, so that such workmen coming accidentally in contact with the wires may not be injured thereby.—Runyan vs. Kanawha Water & Light Company, 71 S. E. 259.

INDUSTRIAL ITEMS.

EDWARD DARBY & SONS COMPANY, Philadelphia, Pa., is making a specialty of the manufacture of Pen-Dar steel lockers and shop equipment. These lockers, which are described in the company's recently published catalog, are said to be fire-proof and thief-proof. For convenience in installation the lockers are made in units, groups or tiers.

THE OHIO BRASS COMPANY, Mansfield, O., recently published the July-August number of the *O-B Bulletin*. Of special interest is an article on "Overhead Electric Practice in Mines. Several diagrams are included and reproductions of photographs show examples of good and bad overhead construction.

THE NATIONAL CARBON COMPANY, Cleveland, O., has published a booklet dealing with the question of commutator slotting. A number of devices for cutting mica from between commutator bars are shown and the importance of giving time and pains to the proper care of the commutator is especially dwelt upon.

THE GENERAL VEHICLE COMPANY, Long Island City, N. Y., gives in the August number of *Elec-Tricks*, a table of the comparative costs of operating an electric vehicle as compared with a horse and wagon. The figures compiled by the Denver Gas & Electric Light Company, show that while the cost of operation of an electric vehicle is only 8.5 per cent more than the maintenance of a horse and wagon, the electric does about 70 per cent more work. This company states that it will make its delivery system exclusively an electric-vehicle one.

CHARLES A. STRELINGER COMPANY, Detroit, Mich., has mailed copies of its revised catalog of the Brush electric lighting set. While the body of the catalog is practically the same as the former edition, an appendix of twenty-five pages of very good material has been added. This is composed of letters from customers or prospective customers with answers by the company, and aside from giving a great deal of information regarding the sets this is prepared in such form as to be very interesting reading. The catalog is well supplied with half-tone engravings and diagrams.

THE LAGONDA MANUFACTURING COMPANY, Springfield, O., announces that its product, the Lagonda automatic cut-off valve, is the only valve which has been admitted to the Museum of Safety Devices, which is maintained in the Engineering Societies Building, 39 West Thirty-ninth Street, New York. The valve, as described in recently issued circular matter, is so made as to close automatically if a break occurs on either side of the valve. The circular described some tests made at Washington in January, 1909, in which a four-inch valve was used, showing the reliability of the mechanism.

THE KEYSTONE ELECTRICAL INSTRUMENT COMPANY, Philadelphia, Pa., announces an important change which recently took place in its management. Richard P. Brown becomes president in place of J. Franklin Stevens, who resigned. J. W. W. Cornman will continue in the office of secretary. Mr. Brown has for a number of years been president of the Brown Instrument Company, the oldest concern in the United States manufacturing pyrometers, and has had wide experience in the design and manufacture of scientific instruments. The companies are now in a position to manufacture practically any type of instrument. In addition to the works and office at Ninth Street and Montgomery Avenue, Philadelphia, an office will be maintained for the present at 311 Walnut Street and branch offices of the Brown Instrument Company at Pittsburg and Chicago will now also handle a line of Keystone instruments.

THE H. W. JOHNS-MANVILLE COMPANY, New York, N. Y., is distributing its new electrical supplies catalogue No. 15, which contains over 400 pages, and illustrates and describes the electrical products of the company. The catalogue is very attractive in design, and contains many new additions to the already extensive line of electrical supplies, among which should be mentioned J-M fibre conduit, for telephone, lighting, railway and electrical purposes; J-M linolite system of illumination for general lighting, third-rail insulators, high-tension porcelain insulators, incandescent lamps and lighting arresters. A new solder known as Solderall is also described, consisting of a non-corrosive flux, combined with solder in paste form, and contained in collapsible tubes. The catalogue should prove a ready reference book, assisting engineers in readily selecting "J-M" products, as it is well arranged and completely indexed.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., has issued a thirty-six-page bulletin entitled "The Selection, Installation and Wiring of Interphone Systems." This is the most complete and comprehensive bulletin ever written on the subject of interior telephone systems and is illustrated with sixty-

six cuts and diagrams. Twelve different systems are described in this bulletin, and in it are also shown sets ranging from the No. 1327 type, a set used for two- to six-party, common ringing and common talking service, to the No. 1335 type, a set used for twenty-four station installations where selective ringing and selective talking are desired. This bulletin tells how to choose the best system for every conceivable service, and gives valuable information on the installation of the sets. The section of the bulletin describing the various methods of running and connecting cable, the method of installing the sets and forming the cable at the cable terminals, is especially valuable, as it is profusely illustrated and shows just how the work of installation is to be done.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has issued a publication on the subject of motor-generator sets. This bulletin, No. 4849, contains brief descriptions of generator sets of different styles and sizes. These sets are made up of various combinations of alternating and direct-current generators and motors, and range in capacity from ninety-five kilowatts to over 7,000 kilowatts. A bulletin, No. 4858, on the subject of single-phase repulsion motors has been issued replacing a former publication. Bulletin No. 4866 replaces all previous bulletins devoted to the Thomson horizontal edgewise instruments for switchboard service. In bulletin No. 4867 are described and illustrated electric locomotives for switching and light freight service, varying in weight from twenty-two to thirty-five tons, according to the service requirements and type of electrical equipment employed. The electrical equipment of these locomotives is of medium capacity, arranged for slow speeds, and it is essential that the design be as simple as possible and that all parts should be readily accessible. In general, the equipment comprises four fifty-horsepower motors and Sprague-General Electric Type M control. Where two locomotives are operated together, multiple-unit cable couplings are supplied. In bulletin No. 4868 are illustrated and described rotary converters for railway and lighting, in capacities ranging from 25 to 2,500 kilowatts. The bulletin illustrates also a portable substation in which a converter is installed. Bulletin No. 4872 describes an outfit manufactured by the General Electric Company for the purification of transformer oil of all kinds, crude petroleum for oil-fired furnaces, insulating varnish and japan, benzine used for cleaning purposes, transformer oil used for impregnating insulating pressboard and wood, cylinder oil used in certain type of electrical apparatus, and viscous insulating compounds. The apparatus consists of a revised and remodeled design of the best type of filter press available, a pump, and a motor for driving. All are mounted on standard steel "I" beams which form skids and greatly facilitates handling.

DATES AHEAD.

Institute of Operating Engineers. First annual convention, New York City, September 1-3.

Old Time Telegraphers' and Historical Association and the United States Military Telegraph Corps. Thirtieth annual reunion, Atlantic City, N. J., September 5-7.

Central Electric Railway Association. Annual convention, Cedar Point, Ohio, September 5-8.

Pennsylvania Electrical Association. Annual convention, Conneaut Lake, Pa., September 6-8.

International Association of Municipal Electricians. Annual convention, St. Paul, Minn., September 12-15.

Vermont Electrical Association. Annual meeting, Lake Dunmore, Vt., September 13-14.

International Municipal Congress and Exposition. Chicago, Ill., September 18-30.

Northwest Electric Light and Power Association. Annual convention, Spokane, Wash., September 21-22.

American Electrochemical Society. Twentieth general meeting, Toronto, Canada, September 21-23.

Illuminating Engineering Society. Annual convention, Chicago, Ill., September 25-27.

American Mining Congress. Thirteenth annual meeting, Chicago, Ill., September 25-30.

American Electric Railway Association and affiliated associations. Annual convention, Atlantic City, N. J., October 9-13.

Association of Railway Electrical Engineers. Annual convention, La Salle Hotel, Chicago, November 6-10.

National Electric Light Association. Next annual convention, Seattle, Wash., June 10-14, 1912.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) August 15, 1911.

1,000,384. MOTOR-STARTING SWITCH. Fred G. Dustin, Minneapolis, Minn. Filed Feb. 6, 1911. Has an intercepting device operative to interrupt the movement of a contact carrier and hold it with the motor-lead contact temporarily engaged with the starting contact, and an operating handle for the contact carrier movable to set this in an operative position but returnable independently.

1,000,389. INSULATOR BRACKET. Charles G. Ette, St. Louis, Mo., assignor to Ette Investment Co., St. Louis, Mo. Filed Aug. 31, 1910. Comprises an approximately yoke-shaped member having the central portion of its cross web widened so as to afford a substantial bearing for the member on the support which it embraces, means on the member for carrying the insulator, and a hinged or pivotally mounted strap that closes the open side of the member.

1,000,392. MAGNETIC SEPARATOR. Eugene J. Feeley, Fairfield, Conn. Filed Feb. 18, 1911. The material to be separated falls on a belt which passes around a wheel provided with electromagnets.

1,000,396. APPARATUS FOR PRODUCING ELECTRIC OSCILLATIONS. Roberto Clemens Galletti, Rome, Italy. Filed Dec. 4, 1908. An oscillatory circuit has inductances and capacities connected in series, spark gaps between the terminals of two or more of the capacities, and means whereby a discharge taking place in one spark gap increases the difference of potential between the electrodes of another spark gap, inducing a discharge of the latter and thus causing a continuous progression in the discharge of the several capacities.

1,000,397. PRODUCTION OF CONTINUOUS WAVE-TRAINS BY MEANS OF PRIMARY SPARK-CIRCUITS. Roberto Clemens Galletti, Lyon, France. Filed June 24, 1910. An oscillatory system of circuits comprising in combination a plurality of spark gap circuits having a common inductance, a common condenser, and each a separate condenser with an armature in common with the common condenser, and means whereby the resulting capacities of each spark gap circuit may be charged.

1,000,401. SIGNALING SYSTEM FOR RAILWAYS. Henry W. Griffin, New York, N. Y., assignor to the Union Switch & Signal Co., Swissvale, Pa. Filed Sept. 21, 1908. Comprises an interlocking relay controlling the motor circuit, and circuits controlled by the movement of a train over track sections to operate the relay to clear the indicator when a train moves past it in one direction and to leave it at danger when a train moves past it in the opposite direction.

1,000,402. SIGNALING SYSTEM FOR RAILWAYS. Henry W. Griffin, New York, N. Y., assignor to the Union Switch & Signal Co., Swissvale, Pa. Filed Sept. 21, 1908. An electric block system.

1,000,418. SHIPPER-RELEASING MECHANISM FOR ELECTRICALLY CONTROLLED WARP STOP MECHANISM. Charles D. Lanning, Boston, Mass. Filed Dec. 30, 1905. Consists of a magnet secured to the loom-frame, an armature therefor, means connected with the armature which act directly to release the shipper when the armature is operated, drop-bars normally supported by the warp-threads, a pair of terminals of opposite polarity, in proximity to the drop-bars and adapted to be connected by the fall of a drop-bar when released by a warp-thread, an electric circuit which includes the magnet and terminals, and a cut-out for the terminals which is operated by the magnet when the circuit is closed by a drop-bar.

1,000,421. PRIMARY ELECTRIC BATTERY. George A. Lutz, Plainfield, N. J. Filed May 29, 1909. The combination of an insulating block provided with a gain, a depolariing plate coacting with the gain, a positive electrode supported adjacent to the plate, and a frame for the plate supported by the block.

1,000,440. ELECTROMAGNET COIL. Frederick W. Reeves, Pittsburg, Pa. Filed Dec. 28, 1909. A coil having the turns formed into a series of steps, each individual step having a different resistance, the step offering the least resistance being the innermost turns, the coil winding being in the same direction throughout its entirety.

1,000,452. COMBINED LAMP AND SHADE HOLDER. James Stoddart, Newark, N. J., assignor to the Enos Co., New York, N. Y. Filed May 31, 1911. The incandescent lamp is held in the shade in such a way as to be easily adjustable.

1,000,471. ELECTRIC LAMP. Samuel P. Wilbur, Pittsburg, Pa., assignor to Nernst Lamp Co. Filed Sept. 14, 1909. A bifurcated hook secured to a support-base has a light-emitting member detachably secured to it at one end, a bifurcated hook detachably secured to the opposite end of said light-emitting member and means for yieldingly mounting the latter hook on said base.

1,000,482. ELECTRICAL THERMOSTAT. William P. Allen, Moon township, Allegheny County, Pa. Filed July 11, 1910. An airtight chamber is made with heavy walls so that sudden increases of temperature do not expand the enclosed air. With a

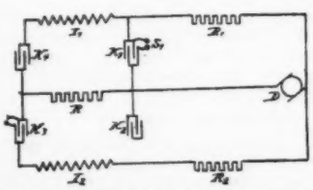
slow increase the expanded air raises a diaphragm completing an electric circuit.

1,000,488. PARTY-LINE TELEPHONE SYSTEM. William M. Bruce, Jr., Springfield, O., assignor to the American Automatic Telephone Co., Rochester, N. Y. Filed Aug. 16, 1907. The combination with the rotating step-up and selector device operated by a single stroke of an operating lever and adapted to send electrical impulses of different characters over the line connecting the several stations, and automatic ringing devices also connected to the rotating device adapted to close a circuit with an alternating-current supply across the line when the device has made a complete movement.

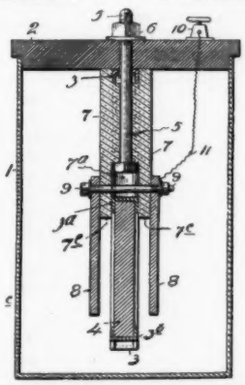
1,000,493. INSULATOR FOR ELECTRIC-RAILWAY CARS. John Christensen, Evans City, Pa. Filed Sept. 27, 1910. An insulating bushing surrounds the exterior portion of the bolt and extends into a casing, having a flange on its end within the casing. An insulating body in the casing surrounds the head of the bolt and rests upon the bushing flange.

1,000,499. TELEPHONE TRANSMITTER. William W. Dean, Elyria, O., assignor to the Dean Electric Co., Elyria, O. Filed Apr. 24, 1908. Comprises a casing, carbon resistance-varying means supported from the casing and adapted to form part of an electric circuit and means to increase the resistance of the varying means when the flow of current is increased.

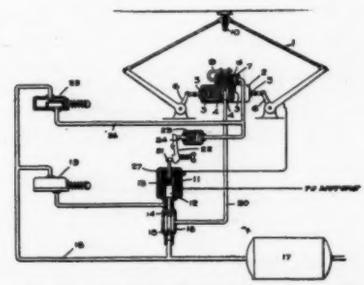
1,000,535. INSULATOR. Louis McCarthy. Boston, Mass. Filed Feb. 26, 1909. An insulator is composed of two members re-



1,000,396.—ELECTRIC OSCILLATION APPARATUS.



1,000,421.—PRIMARY BATTERY.



1,000,779.—TROLLEY-CONTROL SYSTEM.

sembling the member of a loosely fitting ball and socket joint. The space between the members is filled with an insulating material, making a solid piece.

1,000,536. ELECTRIC-SWITCH-OPERATING ROD. Charles R. Meston and Herbert I. Finch, St. Louis, Mo., assignors to Emerson Electric Manufacturing Co., St. Louis, Mo. Filed July 6, 1910. Has a sleeve screwed at one end and is threaded at its opposite end to engage a switch spindle, a collar being slidably mounted on the sleeve, and a spring surrounding the sleeve and engaged between a portion of it and the collar.

1,000,572. SIGNALING APPARATUS. George F. Atwood, East Orange, N. J., assignor to Western Electric Co., Chicago, Ill. Filed Feb. 26, 1906. A closed apparatus case contains the telephone apparatus, ringing apparatus, etc.

1,000,580. ILLUMINATING DEVICE. Henry V. Chamberlain, Somerville, and Alfred E. Troop, Roxbury, Mass., assignors to William Gray, Amesbury, Mass. Filed June 4, 1909. An illuminated-sign device for automobiles, etc., in which the lights are placed in a casing back of a transparent sign.

1,000,601. INK-WRITING TELEGRAPH REGISTER. Benjamin Hurd, Nutley, N. J. Filed Dec. 16, 1907. Combines a tape-feeding mechanism, an inking element, an ink well, a wick for carrying ink from the well to the element, and means for shifting the element against the tape upon closure of the circuit.

1,000,608. ELECTROLYTIC APPARATUS. Jeannot W. Kenevel, Philadelphia, Pa., assignor to William H. Mitchell, Media, Pa., Frank W. Tussey, Camden, N. J., and John R. Bonine, Philadelphia, Pa., trustees. Filed Sept. 22, 1910. Comprises a chamber having a porcelain lining, several hoods for covering sections of the chamber, several sets of electrodes, and conducting means whereby a set of electrodes is supported in the chamber by each of the hoods.

1,000,614. WIRING SYSTEM FOR AUTOMATIC TELEPHONE-EXCHANGES. Frank R. McBerty, New Rochelle, N. Y., assignor to Western Electric Co., Chicago, Ill. Filed Aug. 16, 1909. The combination with two pairs of line wires forming in part two metallic telephone circuits, and switching mechanism adapted to extend the circuit of said line wires to other lines, of two sets of parallel conductors each set comprising two pairs of conductors connecting the switching mechanism in circuit with the two pairs of line wires respectively, one of the pairs of conductors in one of the sets being connected in circuit in reverse order to that of the other pairs in said sets, so that cross talk between the telephone lines is prevented.

1,000,679. SUPPORTING AND PROTECTING DEVICE FOR THIRD RAILS. George S. Inman, Chicago, Ill., assignor of one-half to George C. Waterman, Chicago, Ill. Filed Oct. 2, 1908. Comprises laterally arranged sections of reinforced concrete which are adapted to be fitted over the rail and are provided with longitudinally arranged grooves or recesses at their meeting edges which are adapted to be filled with a binding material to bind and seal said sections.

1,000,717. FLAMING-ARC CARBON. Wallace T. Conn, Lakewood, Ohio, assignor to National Carbon Co., Cleveland, O. Filed Mar. 29, 1909. Has an aluminum resistance-reducing wire extending lengthwise therethrough and enveloped by the material thereof, the wire having a portion projecting from one end of the electrode, the projecting portion being flattened and bent back against the side of the electrode.

1,000,721. DIVING HELMET. Anton Cypra, Worcester, Mass. Filed Oct. 26, 1910. Serial No. 589,173. An electric fan operated by a storage battery or an external source of current supplies a current of air from a tank connected to the diver's helmet. An electric light is connected to be operable from an external source or the batteries. A switch is so placed as to be actuated by the diver's teeth.

1,000,776. DYNAMO ELECTRIC MACHINE. Joseph L. Burnham, Schenectady, N. Y., assignor to General Electric Co. Filed Apr. 12, 1909. Renewed Jan. 26, 1911. A variable-voltage self-exciting commutator machine has main brushes displaced from electrical degrees, an auxiliary brush intermediate the main each other by substantially 180 electrical degrees, an auxiliary brush intermediate the main brushes, means for maintaining a substantially constant induced armature voltage between the auxiliary brush and one main brush, and means for varying the induced armature voltage between the auxiliary brush and the other main brush.

1,000,779. TROLLEY-CONTROL SYSTEM. Frank E. Case, Schenectady, N. Y., assignor to General Electric Co. Filed Aug. 24, 1910. Pneumatic means are used for retracting the trolley in case of overload; these being put in operation by the action of an electromagnet.

1,000,794. SIGN HOLDER FOR TELEPHONE-DIALS. Roy Hanmore Gerard, Berkeley, Cal. Filed Nov. 23, 1910. A sign holder is attached to the stationary part of the finger dial of an automatic telephone.

1,000,795. TELEPHONE TRANSMITTER. Felix Gottschalk, New York, N. Y. Filed Aug. 11, 1910. Has a metallic block provided with a rearwardly opening socket and connected with one of the electrodes, the transmitter casing having an apertured portion rearwardly in line with the socket, and the terminal tip of the telephone wire adapted for insertion through the apertured rear portion of the casing for a slip fit engagement in the socket.

1,000,805. ELECTRIC FURNACE. Alois Helfenstein, Vienna, Austria-Hungary. Filed July 21, 1910. A vertical longitudinally disposed electrode is placed between the two girders at the top of the furnace at the entering point of the charge. The second electrode extends along the bottom of the furnace.

1,000,825. CONDUIT CREEPER. Henry G. Lehman, Windber, Pa. Filed Nov. 6, 1909. Is provided with releasable conduit-engaging means consisting of a laterally disposed gripping jaw, pivoted intermediate its ends, and a shiftable cam co-operating with the inner end part of said jaw.

1,000,838. ELECTRICAL FURNACE. Hans Nathusius, Friedenshutte, near Morgenroth, Germany. Filed June 24, 1909. Comprises a hearth, electrodes projecting thereinto, a transformer co-operating with one of the electrodes, one terminal of the primary and secondary coils of the transformer being electrically connected to the electrode.

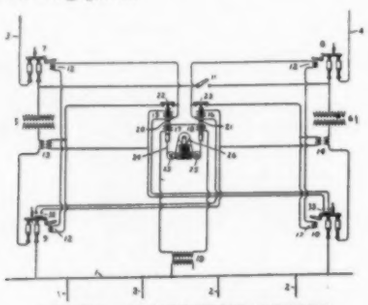
1,000,846. MEANS FOR COOLING DYNAMO ELECTRIC MA-

CHINES. Herman Roos, Berlin, Germany, assignor to General Electric Co. Filed Dec. 8, 1909. A stationary laminated core body has radical inlet and outlet ventilating spaces and axial channels connecting the spaces and a casing having axially extending inlet and outlet chambers which are distributed alternately about the periphery of core body. Space blocks in the ventilating spaces form channels separated from each other, the channels in the inlet spaces connecting with the inlet chambers and the channels in the outlet spaces connecting with the outlet chambers.

1,000,847. BURGLAR ALARM. Gustavus A. Sabine, Robinson, Md. Filed Aug. 5, 1910. Combines a normally open main circuit and devices for closing this at regular intervals, the devices including a pivoted weighted arm, a revolving disk with which one end of the arm contacts, the disk being provided with a cut-away portion to allow the arm to drop, and means for rotating the disk.

1,000,848. STARTING AND SPEED-REGULATING RHEOSTAT. Frank J. Seabolt, Schenectady, N. Y., assignor to General Electric Co. Filed Jan. 24, 1910. Comprises a starting and a speed regulating resistance, a pivoted controlling arm for first starting the motor by a movement in the opposite direction, a no-voltage magnet, and means controlled thereby for causing the arm to be movable with a ratchet movement when it reaches the speed-varying position.

1,000,854. TROLLEY WHEEL. Lewis J. Tetlow, Holyoke, Mass., assignor to New England Trolley Wheel Co., Holyoke, Mass. Filed May 4, 1909. An iron trolley wheel has a trolley-wire bearing portion of a better conducting metal, other parts of the electrical path also being made of better conducting material than the wearing parts.



1,000,934.—PROTECTIVE DEVICE.

1,000,864. MOTOR-CONTROL APPARATUS. David Wald, Otto C. Britsch, and Max Taigman, New York, N. Y. Filed Apr. 15, 1911. A series of contacts connected to resistance coils are attached to a plate. The movement of a switch arm makes and breaks the connection between a pivotally mounted bar and the main contact.

1,000,871. IMMERSION HEATER. Gilbert C. Young, Oceano, Cal. Filed Aug. 9, 1910. Comprises a cylindrical body formed of two semi-cylindrical members of non-conducting material, each of said members having two parallel channels on its inner face, and two longitudinal grooves. Electrodes extend in the channels, connecting the wires in the grooves to the electrodes, and a casing surrounding the electrodes and the adjacent end portion of the cylindrical body hold the members of the cylindrical body together.

1,000,895. RELEASING DEVICE. Everett D. Chadwick, Winchester, Mass. Filed Oct. 8, 1906. An electromagnet trips a trigger releasing a rope which is attached to a rope-securing means.

1,000,902. CALLING DEVICE FOR ELECTRICAL EXCHANGE SYSTEMS. Alfred H. Dyson, Chicago, Ill., assignor to Kellogg Switchboard & Supply Co. Filed Feb. 16, 1906. Comprises a lever provided with a plurality of adjacent finger holds, an impulse transmitter actuated on movement of it to transmit impulses corresponding to the selected holds, and a movable arm actuated on movement of the lever for stopping the lever in a plurality of positions according to the selected holds.

1,000,925. CONDENSER. Karl Kuhlmann, Berlin, Germany, assignor to General Electric Co. Filed Apr. 29, 1910. Is made of a dielectric divided at the point of greatest stress into portions separated from each other to leave a space between them. The cavity contains a material with properties different from the dielectric so that the capacity of the dielectric is varied.

1,000,934. PROTECTIVE DEVICE FOR DISTRIBUTION SYSTEMS. Rudolf M. Ostermann, Bogota, Colombia, assignor to General Electric Co. Filed Nov. 2, 1908. A plurality of tripping relays have members movable into tripping position in response to abnormal conditions. A flexible interlock connected to the members is of a length allowing only one member at a time to reach tripping position, and a spring arranged to exert a strain on the interlock to hold the members in position.

1,000,938. MAGNETIC TESTING DEVICE. Leon J. Le Pontios, New Rochelle, N. Y., assignor of one-half to Benjamin Hurd, Nutley, N. J. Filed May 13, 1908. Comprises a magnet, a movable device between the poles of the magnet (the magnet having extensions beyond this device) and means for insuring an air gap between the surfaces of the extensions and the material to be tested.

1,000,939. ELECTRIC RELAY. Leon J. Le Pontios, New Rochelle, N. Y., assignor of one-half to Benjamin Hurd, Nutley, N. J. Filed July 24, 1908. The primary circuit contains an exciting coil, a driven disk subjected to magnetic flux excited by the coil, a secondary circuit, and means for connecting the disk in the secondary circuit, the relay device being normally incapable of yielding a current of its own.

1,000,941. MEASURING INSTRUMENT. William H. Pratt, Lynn, Mass., assignor to General Electric Co. Filed Feb. 7, 1910. Two relatively movable members each have a coil, these coils being an inductive relation to each other, windings in series with each of the coils, being inductively related to prevent phase displacement of the currents through the coils.

1,000,942. ELECTRIC MEASURING INSTRUMENT. William H. Pratt, Lynn, Mass., assignor to General Electric Co. Filed Feb. 24, 1910. A conical core, a coil axially longer than the core tapered to render its sides substantially parallel to those of the core, and means for mounting the coil coaxially with the core and to permit a relative axial movement between them.

1,000,964. LAMP FOR MOTION-PICTURE MACHINES. John H. Crosier, Philadelphia, Pa., assignor of three-fifths to George N. Powell, Pittsburg, Pa. Filed July 20, 1910. Relates to the mechanical movement of the carriages supporting the electrode.

1,000,967. ELECTRIC SEAM WELDING. Milton J. Farquhar, Wilmington, Ohio, assignor to Farquhar Furnace Co., Wilmington, O. Filed May 14, 1909. The method of welding adjacent edges of metal plates consists in sending an electric welding current through and progressively along the ridge joint, and applying a quick succession of light impacts upon the ridge, in proximity to and progressively with the current.

1,000,972. ELECTROPNEUMATIC PHOTO-EXPOSURE APPARATUS. Karl W. Thalhammer, Los Angeles, Cal. Filed Aug. 12, 1909. Comprises a pneumatic mechanism for operating a camera shutter, an air-tank provided with an outlet, means to compress air in the air-tank, a tube leading from such outlet to the pneumatic mechanism, a valve to normally close the outlet, and electro-magnetic means to open the valve.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired August 21, 1911.

524,706. ELECTRIC-LIGHT SUPPORT. William H. Connell, Wilmington, Del.

524,707. ELECTRIC-LAMP HOLDER. Fay O. Farwell, Dubuque, Iowa.

524,749. SYSTEM OF ELECTRICAL DISTRIBUTION. George Westinghouse, Jr., Pittsburg, Pa.

524,758. ELECTRICAL RAILWAY SIGNAL. Lawrence Dornberger, Highland Falls, N. Y.

524,773. ELECTRIC-RAILWAY SUPPLY SYSTEM. Malone Wheles, Washington, D. C.

524,785. CONTROLLER FOR ELECTRIC CARS. Marion B. Monroe, New Orleans, La.

524,789. ELECTRICAL SUBWAY SYSTEM. John C. Reilly, Brooklyn, N. Y.

524,808. CIRCUIT CONTROLLER. Edward J. McEvoy, New York, N. Y.

524,823. ELECTRIC RAILWAY CAR. John C. Henry, Westfield, N. J.

524,844. ELECTRICAL TESTING SWITCH. Henry Smith, Buffalo, N. Y.

524,845. AUTOMATIC REGULATOR FOR DYNAMOS. Henry D. Symmes, St. Catharine, Canada.

524,881. ELECTRIC HEATER. Tapley W. Young, Washington, D. C.

524,884. COMMUTATOR FOR DYNAMO-ELECTRIC MACHINES. George F. Card, Covington, Ky.

524,911. APPARATUS FOR TRANSFORMING CONTINUOUS ELECTRIC CURRENTS INTO ALTERNATING CURRENTS. Franz S. F. Schneider, Fulda, Germany.

524,925. COIN-CONTROLLED APPARATUS. Byron C. Wolverton, Elmira, N. Y.

524,947. ELECTRIC DANGER SIGNAL FOR RAILWAYS. Archibald B. Murray, San Rafael, Cal.

524,953. ELECTRIC METER. Carl D. Raab, Kaiserslautern, Germany.

524,976. ELECTRIC-RAILWAY SUPPLY SYSTEM. James F. Cummings, Detroit, Mich.

524,977. UNDERGROUND CONDUIT FOR ELECTRICAL CONDUCTORS. James F. Cummings, Detroit, Mich.

524,980. ELECTRIC WIRE COUPLING. Charles K. Hall, and William B. Lillard, New Orleans, La.

524,981. ELECTRIC-ARC LAMP. Rudolph H. Jahr, Opladen, Germany.

524,983. APPARATUS FOR SUPPLYING ELECTRICITY FOR LIGHT AND POWER PURPOSES. Milton M. Kohn, Chicago, Ill.